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ABSTRACT

This volume is the third of three reporting research that is intended to help postsecondary occupational education deans and directors become able to plan more strategically for using new instructional technologies to meet emerging needs. "Planning to Use Emerging Instructional Technologies: Some Useful Methods and Guidelines" (O. W. Markley, Christopher J. Dede, Karla M. Back) describes a relatively simple, but practical, method called "Advanced Back of the Envelope Planning" and two alternative approaches--Entry-Level Strategic Planning and Advanced Techniques for Strategic Planning and Management. The focus shifts to planning that uses instructional technologies, and practical tips and a more tightly focused planning model, a checklist, and 13 references follow. "Intelligence Information for Future-Responsive Planning and Management" (Christopher J. Dede, O. W. Markley) provides a method for developing the "intelligence" needed for effective management of change in public-private settings and a forecast of technological, economic, social, and political factors that will help the reader better understand the trends and issues likely to affect occupational education in the future. A list of 52 references is included. "A Survey of Deans and Directors of Postsecondary Vocational Education in Texas" (Karla M. Back, O. W. Markley) presents results of a needs assessment to determine what instructional technologies are now being used and what future needs are perceived by 29 (out of 50) deans and directors of postsecondary vocational education in Texas. (YLB)

ED307399

PREPARING FOR THE FUTURE OF THE WORKPLACE

VOLUME III: PLANNING MATERIALS FOR EDUCATORS

Prepared for:

The Texas Higher Education Coordinating Board
Community Colleges and Technical Institutes Division

By:

The Institute for Strategic Innovation

June, 1988

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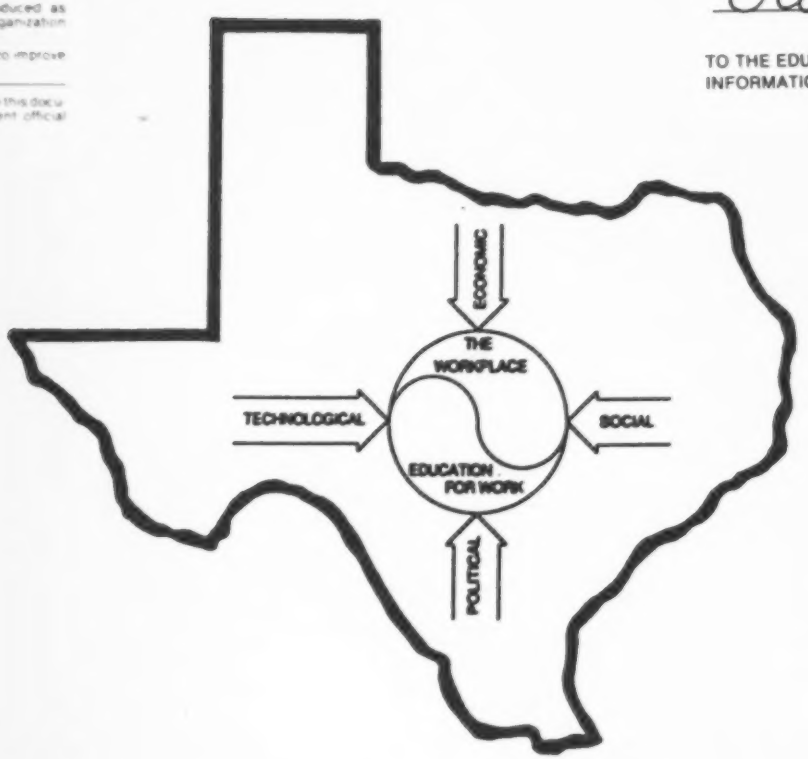

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PREPARING FOR THE FUTURE OF THE WORKPLACE

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EXECUTIVE SUMMARY

Much has been accomplished since the Master Plan for Vocational Education in Texas was formally approved by the Higher Education Coordinating Board in October, 1986, and by the Texas Education Agency in January, 1987, and formally became law with the passage of HB 72. The Master Plan thus has a legal mandate to provide strategic planning directions for occupational education,[1] and public education institutions are required by law to comply.

An even broader planning process is now underway by the Texas Strategic Economic Policy Commission, which is scheduled to release a draft of its strategic plan for the State in mid-July, with hearings on the draft report to occur during August and September, and the final report to be approved by the Governor and released before the end of the year. Because the thrust of this Commission, like that of several previous task forces, is to stimulate economic diversification and development, including the improvement of occupational training in needed new skill areas, it also will set major directions which educators will be required to follow.

The research reported here is intended to help deans and directors of community colleges and technical institutes implement planning objectives which comply with the above requirements--especially those set forth in the Master Plan focusing on the development of educational delivery systems based on:

- Emerging needs
- Competitive, cost-effective, state-of-the-art training technologies

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[1] For convenience we use the term "occupational education" to refer also to "vocational and/or technical education."

. Resource funding and implementation via public-private collaboration, rather than by the public sector only.

It follows an earlier working paper entitled, The Future of the Workplace in Texas: A Preliminary Identification of Planning Issues for Technical, Vocational, and Adult Postsecondary Education, which had the same substantive focus, but was aimed at illuminating policy questions asked by the professional staff of the Coordinating Board in connection with Master Plan implementation.

To make it easier for you to read and use this report, we have: 1) written much of it in the active voice; 2) divided it into three volumes, each of which has the same front matter so that you may either bind them together or separately; and 3) drawn together a selected "Packet of Guidesheets" made up of materials from all three volumes. It is appended to the Executive Summary of Volume I, beginning on page vi.

Many of you may find Vol. III the most useful, because it leads off with a practical set of planning methods and guidelines for utilizing emerging instructional technologies. It then presents more advanced materials: 1) a method for developing the "intelligence" needed for effective management of change in public-private settings; and 2) a forecast of technological, economic, social and political "factors" you can read to better understand the complex variety of trends and issues that are likely to impact occupational education in the future. Finally, in the last chapter, we present the results of a needs assessment conducted to ensure that our materials would meet the expressed needs of deans and directors.

Vol. II contains the findings from three background studies:

- A description and forecast of emerging information technologies, especially those with significance for vocational education;
- An analysis of technology-induced job displacement, especially as it affects women and minorities;
- An analysis of public-private collaboration, especially as it could be used for new initiatives which link economic development and vocational education planning.

Vol. I provides an overview of the entire project, including a summary of important factors and planning issues that you may find useful to consider. It ends with a description of how we followed the methodology we describe in this report as we did the research, and includes some surprises we found as we did so. They provided us with insights we think may be useful for you as well. Appended to Vol. I is information about the Institute for Strategic Innovation, the research team, and acknowledgements.

Together, these three volumes are intended to help you strengthen the institutional capacity of the community college and technical institute system in Texas to engage in education planning for economic development.

The main sections of the three volumes are:

Volume I: Overview

Executive Summary

Packet of Guidesheets

Chapter 1. Vocational Education Planning for Economic Development in Texas, by O. W. Markley

Appendix: Acknowledgments, Project Personnel, and Institutional Description

Volume II: Analytical Studies

Executive Summary

Chapter 2. Emerging Information Technologies of Significance for Postsecondary Occupational Education, by Chris J. Dede

Chapter 3. Technology-Related Occupational Displacement and Training Needs, Especially Among Women and Minorities, by Karla M. Back and O. W. Markley

Chapter 4. Public-Private Initiatives as a Strategy for Promoting Effective Implementation, by Paul C. Fama, Karla M. Back and O. W. Markley

Volume III: Planning Materials for Educators

Executive Summary

Chapter 5. Planning to Use Emerging Instructional Technologies: Some Useful Methods and Guidelines, by O. W. Markley, Chris J. Dede, and Karla M. Back

Chapter 6. Intelligence Information for Future-Responsive Planning and Management, by Chris J. Dede and O. W. Markley

Chapter 7. A Needs-Assessment Survey of Deans and Directors in Texas, by Karla M. Back and O. W. Markley

CHAPTER 5

PLANNING TO USE EMERGING INSTRUCTIONAL TECHNOLOGIES: SOME USEFUL METHODS AND GUIDELINES

by:

O. W. Markley, Christopher J. Dede and Karla M. Back

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CHAPTER 5

PLANNING TO USE EMERGING INSTRUCTIONAL TECHNOLOGIES: SOME USEFUL METHODS AND GUIDELINES

The Technology Life Cycle and Skill Training

If you are not familiar with the range of new information technologies described in Chapter 2, it can be bewildering to confront the gap between the technologies you now use/are familiar with, and those you may need to prepare to use in the next several years. A useful way to approach this problem is to see the gap as a necessary part of the cycle through which new technologies are invented, introduced, and implemented--replacing older technologies of the past, and only to be replaced in turn by still newer technologies of the future. Several years ago, for instance, the typewriter began being displaced by the computer-based wordprocessor. More recently, the stand-alone wordprocessor is beginning to be displaced by a new generation of software which integrates word processing, spreadsheets and data base management, together with graphics and "desk top publishing" capabilities by means of an over-arching system that allows many different personal computers to "talk to each other" and with it.

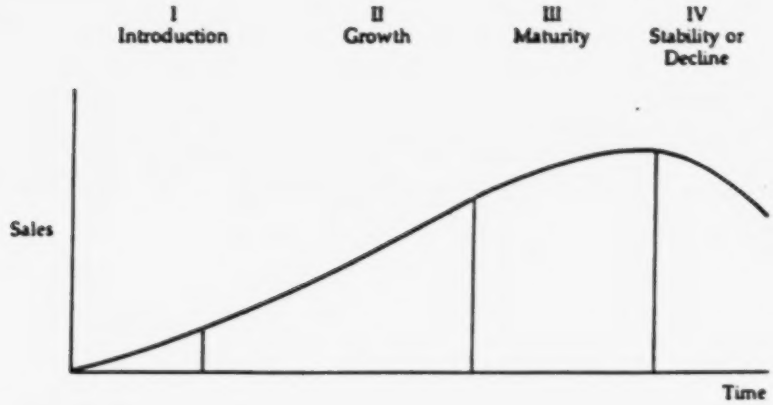
And as Chapter 2 indicated, "hypermedia" software is already visible over the horizon which will, in its turn, displace much of this new "integrated" software with a still deeper and more systemic type of integration.

A model that makes it easy to see the transition from one generation of emerging technology to the next is the so-called "product life cycle" curve. A way of picturing the life-cycle curve which we have found very useful is juxtapose it with implications for skill training, such as Patricia Flynn (1988) did when she studied the impacts of new technologies on economic development, skill requirements, jobs and workers in the greater Boston area. As you can see in Exhibit 5.1, in the early stages ("Introduction" and "Growth") of a new technology (for example,

EXHIBIT 5.1

THE TECHNOLOGY LIFE-CYCLE CONCEPT AS APPLIED TO SKILL TRAINING

The Product Life Cycle



Characteristic	Phase			
	I	II	III	IV
Product	Variable; often custom designs	Increasing standardization		Mostly undifferentiated; standardized
Product innovation	Frequent experimentation; major changes	Declining rate		Minor refinements, if any
Volume	Small-scale	Rising volume	Large scale	Large scale
Process	Job-shop; batch production	Increasingly automated	Capital-intensive mass production	Capital-intensive mass production
Process innovation	Exploratory	Relatively high rate; major innovations	Rate declines	Minor refinements, if any
Equipment	General purpose	Increasingly specialized		Special purpose

Adapted from: William J. Abernathy and James M. Utterback, "A General Model," Chapter 4 in W. J. Abernathy, *The Productivity Dilemma* (Baltimore: Johns Hopkins Press, 1978), pp. 68–84.

The Skill-Training Life Cycle

	Phase			
	I Introduction	II Growth	III Maturity	IV Stability or Decline
Tasks	Complex	Increasingly routinized		Segmented
Job skills	Firm-specific	Increasingly general		General
Skill training provider	Employer or equipment manufacturer	Market-sensitive schools and colleges	Schools and colleges more generally	Schools and colleges; some skills provided by employers
Impact on job structures	Job enlargement; new positions	Emergence of new occupations		Rigid job hierarchy with formal education and occupational work experience requirements.

Source: Flynn, P. Facilitating Technological Change: The Human Resource Challenge. Cambridge, MA: Ballinger, pp. 12 & 19, 1988.

personal computers) or technological product (e.g., word processor), skill training is typically provided by the vendor or on-the-job. Only later on (in the "Maturity" or "Stability/ Decline" stages) do public sector institutions typically provide skill training for a wide variety of students--and the PSIs do this even as a new replacement technology may be starting to be adopted by "leading edge" business/industry sites. A good question to ask is, "Where should our organization position itself regarding these stages?"[1]

A "Thought Experiment"

As a way of addressing the above question, you might like to ask yourself, "In the organizations I am familiar with in our region, how was the transition made from typewriters to stand-alone wordprocessors?" Who provided the training for secretaries in the organizations which used the earliest models? How (and when) did the secretaries in public educational institutions learn these skills? And when was it that your community college(s) started offering classes in word processing? This represents the past for most, but not all PSIs.

Now think about what you know or have heard about the new integrated applications software, or "local area networks" (LAN). Who do you know that is using it in your community? Is it being used yet by your administrative people? What training needs do you think exist now, or will exist in two or three years, for this type of application? Who should provide this training, at what points in the curve on Exhibit 5.1?

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[1] As an indication of how useful we found this model, it appears in Chapter 3 in connection with gender discrimination in job displacement; and in Chapter 4 in connection with public private initiatives (and in the Summary Overview in Chapter 1 as well)--even though the treatment here is meant to be its introduction in this report.

The Purpose and Plan of This Chapter

Deans and directors of postsecondary vocational, technical, and adult education feel quite able to manage planning and program development tasks which respond to existing needs with existing methods. But when confronted with the challenge of looking ahead far enough to plan programs that would use emerging technologies to meet emerging needs of the workplace in their region, it is often much less clear how to proceed.

The purpose of this chapter is to set forth several models and specific guidelines that you can adapt to the needs of your specific institution and region. To maximize the likelihood that these suggested resources would be as useful to you, the method of approach was as follows:

1. We conducted a needs-assessment survey of all community college deans and directors in Texas. The details of this assessment, which had a 58% response rate, and its results are described in Chapter 7. Essentially, though, most respondents indicated that they had little awareness of many advanced instructional technologies that the forecast in Chapter 2 indicated are likely to emerge. Given a choice, they would prefer that we suggest detailed planning guidelines, rather than more generic models.

2. We reviewed the planning literature, looking in particular for practical guidelines for carrying out the type of planning mandated by the Master Plan. Based on this review and consultation with our advisory panel, we decided that although good models and guidelines do exist in the literature, all were either too simplistic, or too complex and advanced to fit the very practical (but non-simple) needs of deans and directors. We therefore decided to formulate our own.

In what follows, therefore, we begin by first describing in some detail a relatively simple, but practical method, somewhat sardonically called "Advanced Back of the Envelope Planning." We then identify two alternative approaches to planning ("Entry Level Strategic Planning" and "More Advanced Techniques for Strategic Planning and Management"), each of which has a successively greater level of complexity and difficulty. The section concludes with an analytical framework for considering different types of institutions and which planning method might be best for each.

The chapter then shifts from planning as a generic topic to focus specifically on planning that utilizes instructional technologies. A number of practical tips are given, followed by yet another, but even more tightly focused, planning model and checklist.

Advanced Back of the Envelope Planning

It is widely recognized that most managers, both in the public and private sectors, view formal planning as a necessary evil. It is not only difficult to do, but once formalized and implemented as initially conceived, it often limits the freedom to react to unforeseen exigencies. So it is not surprising that much planning closely resembles what may be metaphorically labeled "back of the envelope" planning--the sort we all do when jotting down informally what we need to do to fulfill our responsibilities. When using this approach at an institutional rather than personal level, however, it is harder to know "what to write on the envelope." Nor is it easy to align other management plans at the institutional level. Our purpose here is to show how this can be done.

A Checklist for "Back of the Envelope" Planners. Exhibit 5.2, lists a number of questions that are useful to answer when considering a new project or program. "X" may refer to vocational education in general, to skill retraining for recently displaced workers, or any other concern.

EXHIBIT 5.2

A CHECKLIST OF "BACK OF THE ENVELOPE" PLANNING QUESTIONS

1. **Vision**. What are my (my group's) predominant ⟨ . hopes / . fears / . expectations ⟩ regarding the future of "X"?

2. **Direction**. What do I (we) particularly want to ⟨ . protect / . maintain / . achieve / . change / . create ⟩ in the ⟨ . short / . medium / . long ⟩ range?

3. **SWOT**. What are the main ⟨ . strengths / . weaknesses / . opportunities / . threats / . other factors ⟩ that need to be considered? In particular, what obstacles would prevent success if not overcome or otherwise addressed?

4. **Networking and Huddling**. How, and with whom, do I want to plan for action? What are their considerations about "X?"

5. **Technology**. What methods, tools, or strategies look promising? How rigorously might we want to use each?

6. **Commitment**. How much time and effort am I (and others I can count on) willing to dedicate to this, and for how long? What other resources are likely to be available if needed?

7. **Payoff**. Assuming that adequate time and effort is expended to implement the plans, within likely resource constraints what outcomes can realistically be expected, and when?

8. **Go/No Go.** Given whatever answers you have to the above questions, is the venture really worth doing? If so, who should do what? When? What are the first steps? If not, is there anything else that makes sense to do?

Some brief comments on these items may be helpful.

1. **Vision**. All professionals, and the organizations they represent, have concerns that predominate as they think about what is worth doing. Less frequently do they express these concerns in terms of the future. This question helps make your thinking and planning more responsive to future needs, rather than merely reactive to past conditions; and it also can help to realistically balance optimistic and pessimistic perspectives.

NOTE: It helps, at the outset, to identify "Makers" (people whose commitment will be needed if the plan is going to work) and "Breakers" (people who, if they so chose, could kill it even though they may not be directly involved), and to look at the specific question being asked from each point of view.

2. **Direction**. If you did a formal needs assessment, what might it reveal--in regard to both emerging and current needs? In addition to objectives that can be stated formally, what are some of the politically sensitive needs that, although not to be written in a formal report, can be "written on the back of your own personal envelope." What do your Makers most want to achieve? What would spur your Breakers into protective action? Finally, needs are paramount now--or, more specifically, what needs to be achieved now in order to buy position for later?

3. **SWOT**. The assessment of institutional strengths and weaknesses for responding to existing or emerging opportunities and threats is the most agreed upon element in modern day strategic planning. Like the previous questions, this can be explored by an individual or in a group; on behalf of both the institution most directly involved, as well as other indirectly affected groups.

4. **Networking and Huddling**. "Networking," a relatively recent term, is a strategy for dealing with people, organizations and change in a more informal, decentralized, and less hierarchical manner than usual. It involves sensing whatever "systems" need to be tapped for your system to go (Lipnack and Stamps, 1982). "Huddling" refers to the process of touching in

with whoever needs to be in on things (especially "Makers" and "Breakers") to get their advice or consent (Merrill, 1979). The recent book, In search of Excellence (Peters and Waterman, 1984) used the term "management by walking around" to express a similar concept.

5. Technology. Here it is useful to distinguish between the technology that is for you an "end item" (e.g., an instructional system using programmable videodisk technology), and technologies that you may use in order to identify, assess, procure, train and implement the end item successfully (e.g., the DACUM process of curriculum design). In the "back of the envelope" method of planning, it is important to be explicit about the different types of technologies that will be involved. Will they be used in a relatively rigorous, formal way, or will they be "adopted in spirit" in a way that is less formal and more "ad hoc."

6. Commitment. Are there enough available resources to do each thing needing to be done well enough for successful implementation--considering that many as yet unidentified problems will almost surely occur?

7. Payoff. Here it is often wise to look at "upside" and "downside" possibilities, rather than at a mid-range estimate only. In light of the above, what is the best that can reasonably be expected? How likely is it? Is it worth striving for, even at the expense of other things? What is the worst that can reasonably be expected? Could you live with this result?

8. Go/No Go. If the above questions have been answered in a preliminary, "back of an envelope" fashion, this last question may point to the need for a more formal way of addressing the same concerns, such as the approaches described below. Or, it may lead to a continuation of informal actions focused on getting the job done appropriately, given the particular situation.

Entry Level Strategic Planning

Of the many books and articles on the topic of strategic planning and its application to education, perhaps the most attractive is the small 6"X9" 86-page manual, Guide to Strategic Planning for Educators, by Shirley D. McCune (1986). This book presents a view of strategic planning that is midway in complexity between the approach described above and that cited below, and it includes a general model, guidelines and examples to help you create a formal (though initially simplified) approach that fits your own unique needs. Its table of contents, together with its cost and the address where it can be ordered, are presented in Exhibit 5.3.

Advanced Strategic Planning and Management

The third and final approach we would recommend was developed by a number of experts drawn together by the United Way of America and set forth in a set of practical guidebooks under the title: Strategic Management and United Way--A Guideline Series.[2] Exhibit 5.4 lists the contents of this guideline series, plus related materials, costs, and the address where all can be ordered. Although a number of textbooks offer more theory, this series represents the most detailed practical material available on strategic planning and management for public sector agencies. Of course, since it was prepared for use by regional United Way organizations, educational users will need to adapt its advice to their own needs. This, however, is easy enough to do.

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[2] A recently published strategic planning text which came to our attention just as this report was going to press is also useful to cite due to the number of practical "guidesheets" it contains. It is: Strategic Planning for Public and Nonprofit Organizations: A Guide to Strengthening and Sustaining Organizational Achievement, by John M. Bryson (San Francisco: Jossey-Bass, 1988).

EXHIBIT 5.3

TABLE OF CONTENTS FROM
GUIDE TO STRATEGIC PLANNING FOR EDUCATORS
BY SHIRLEY D. McCUNE

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This book is available at a cost of $6.00 from:

Association for Supervision and Curriculum Development
125 North West Street, Alexandria, VA 22314-2798
703-549-9110

EXHIBIT 5.4

RELEVANT MATERIALS ON STRATEGIC PLANNING AND MANAGEMENT AVAILABLE FROM THE UNITED WAY OF AMERICA

A. Strategic Management and United Way--a Guideline Series. Catalog No. USP0524, costs $100, and contains the following booklets, bound in a three-ring binder:

1. Strategic Management and the United Way. An overview of their strategic process model, including major stages, costs, benefits, and directions on how to begin.

2. Environmental Analysis. How to do environmental scanning, monitoring and scenario development to represent external threats and opportunities the organization needs to consider.

3. Organizational Assessment. How to identify and evaluate the competitive position of the organization and its internal strengths and weaknesses in dealing with external threats and opportunities. Includes comparative analysis of organizations, analysis of performance history, self-assessment, surveys, interviews, and focus groups.

4. Strategic Direction. How to combine results from both environmental analysis and organizational assessment to define or redefine the mission, form objectives, and identify strategic issues the organization must consider.

5. Strategic Plan. How to formulate and document alternative courses of action, and set forth how the organization will fulfill its mission and objectives in light of critical issues.

6. Implementation. How to organize, motivate, and manage people to fulfill the plan.

7. Performance Evaluation. How to compare what was planned with actual or anticipated results; and to adjust strategies, resources, and timing in light of experience gained since the project was begun.

B. What Lies Ahead--A Mid-Decade View (An Environmental Scan Report). Catalog No. USP0502N, $15. Provides perspectives, forecasts, and supporting documentation on the broad and ever-changing environment in which public sector organizations will operate during the balance of this decade and into the 1990s.

C. 1987 United Way Catalog. Catalog No. USS0291, free. A variety of media products on volunteerism, planning and communication, including slide shows and videotapes on planning for new technologies. This and the above materials may be ordered from:

Strategic Planning Division
United Way of America
701 N. Fairfax St.
Alexandria VA 22314-2045
703-836-7100

Suggestions for "Planning to Plan"

In considering the different types of postsecondary institutions that are responsible for postsecondary vocational, technical, and adult education, and how such differences affect the utilization of various technologies (both planning and end-item technologies), we found it useful to develop an analytic framework for making comparisons and contrasts regarding useful practice. It is useful for "planning to plan," that is, deciding what type of planning method to use, and just how you want to adapt it to your needs.

In this framework, three different types of PSI are distinguished:

1. Small with few resources, but with high awareness of and commitment to planning and utilization of emerging instructional technologies;
2. Medium-to-large with relatively great resources, plus high awareness of and commitment to planning and utilization of emerging instructional technologies; and
3. Large or small, regardless of resources, but with low-to-medium awareness of and commitment to planning and utilization of emerging instructional technologies.

Similarly, three different time frames are given:

1. Short-range, 1-2 years, although users should define this for themselves;
2. Medium-range, 2-5 years, although in practice for many this is long range; and
3. Long-range, perhaps 5-10 years.

Exhibit 5.5 consists of a matrix in which each of the above dimensions is used as an axis. In the cells of this matrix, we have noted our best estimate regarding which of the three approaches to planning might be most suitable for planning in your type of institution.

EXHIBIT 5.5

PLANNING METHODS THAT MAY BE ESPECIALLY RELEVANT
FOR DIFFERENT TYPES OF INSTITUTIONS
IN DIFFERENT TIME FRAMES

Type of District	Short Range (1 - 2 years)	Medium Range (2 - 5 years)	Long Range (5 - 10 years)
Small and resource-limited, but with high awareness and commitment	Planning Method 1	Planning Method 1, informed by Method 2	Planning Method 2 or 3
Medium-to-large, resource-wealthy, plus high awareness and commitment	Planning Method 2	Planning Method 2 or 3	Planning Method 3
Large or small, regardless of resources, with low-to-medium awareness and commitment	Planning Method 1	Planning Method 1	Planning Method 1

Note: The three planning methods, which are described in the text, are:

Method 1: "Advanced Back of the Envelope Planning"

Method 2: "Entry Level Strategic Planning"

Method 3: "More Advanced Techniques for Strategic Planning and Management"

Planning Guidelines for Utilizing Emerging Instructional Technologies

This section outlines some practical strategies that postsecondary vocational, technical, and adult educators can apply in planning for new pedagogical devices and delivery systems. The strategies can be used with any of the three approaches to planning noted above.

As discussed in Chapter 2, **Emerging Information Technologies of Significance for Postsecondary Occupational Education**, the speed with which intelligent instructional workstations are implemented depends on several factors. These include:

- how rapidly the power and capability of educational technology develops, and how much the cost declines
- how quickly the workplace responds to technological advance and global competition
- the amount and kinds of resources made available to educators for purchasing hardware, developing courseware, and retraining instructors
- how educators react to changing their professional skills and organizational structures

This chapter presents thirteen informal heuristics (rules of thumb) for managing the orderly evolution from current pedagogical models to more advanced instructional technologies. No maxim is always correct, but the following can help in avoiding some common pitfalls. A illustrative checklist to aid in evaluating new devices for postsecondary occupational instruction is also included.

Guidelines for Managing Change

So, you are considering a new instructional technology... Given the power of these workstations and their potential for revolutionizing the workplace, such a change makes sense. However, altering your pedagogical model by adding technology might have drawbacks. Here then are a "baker's dozen" recommendations about managing this type of innovation.

1) Don't Buy Anything Until You Have Determined Why You Need It

Advanced information technologies are attractive, in part because computers and telecommunications give a "high tech" aura to your institution. Students, faculty, alumni, regents, business leaders, and other important people are impressed by seeing room after room of such costly equipment. Unfortunately, many of these devices could end up as expensive doorstops, if you fail to evaluate carefully in advance how educational technology can meet your specific instructional needs.

The temptation is to buy the hardware first and worry about what to do with it later. We often use this approach with more common technologies: we don't plan out all our trips before buying a car or list all prospective albums to purchase before acquiring a phonograph. However, information technology hardware is useless without appropriate software to accomplish certain tasks, and vendors at times will market expensive equipment, regardless of the availability of courseware. Moreover, even good instructional materials won't be used unless they fit into your curriculum. A "needs analysis" is vital beforehand to ensure that neither hardware nor software ends up collecting dust.

In brief, the optimal purchasing strategy for instructional devices is as follows:

a. assess instructional needs;

b. determine whether emerging educational technologies can meet those needs;

c. scan for the best software to deliver the capabilities required;

d. choose a hardware systems that complements that software.

Then, carefully select a purchasing team to recommend equipment and software purchases. This group should represent a cross-section of those who will actually be using the devices. As a failsafe, include a few sceptics to ensure that enthusiasm for a particular technology doesn't blind the team to its

potential defects.

2) Never Believe a Manufacturer's Claims Until You See The Technology In Action

The three major types of instructional technology are hardware, software, and vaporware. "Vaporware" refers to any device or program that has yet to reach the market - i.e., is planned, announced, being developed, in beta-test, available next month, or being shipped. In brief, this is anything you cannot see and touch right now and includes computers, telecommunications, "black boxes" that interconnect devices, programming languages, manuals, training videos, and courseware.

Information-technology vendors generate vaporware for a variety of reasons:

- announcing a new product makes a company appear to be an industry leader and can persuade potential customers to wait rather than buy from competitors;
- taking orders for a product that has not yet been developed is a way of determining whether sufficient demand exists to warrant its creation;
- product development takes ninety percent of the expected total time until release; the final ten percent goes toward perfecting the product.

Vendors have often released products years after advertising them and taking orders. Sometimes a new idea can never be made to work, and the product is quietly "withdrawn" (or the company collapses).

Never buy anything you cannot "test drive." Watching a demonstration won't do, because presentations can be crafted to conceal potential problems and often do not indicate whether the device or software has the particular capabilities you need. A product is "available" when you can personally try using it to accomplish your specific tasks.

3) Pioneering A Product Is A Mixed Blessing

Being "the first on your block" to own a new product can be exciting and glamorous since your institution is now established as a leader. However, spearheading the implementation of an innovative instructional application has subtle costs. Typically, first-generation devices and software contain unknown flaws or sell for inflated prices.

All components of instructional technologies have hidden problems. The more complex an application and sophisticated its functions, the greater the number of "bugs" it contains. Vendors, of course, spend much time and money testing products before they are sold, but the final stage of debugging occurs typically during the first six months of use. Consumers act as guinea pigs during this final stage of testing; consumer complaints reveal the flaws that in-house evaluation missed.

The good news is that upgrades and improvements under warranty tend to be handled free. The bad news is that 1) the technology may not work reliably until modifications have been made and 2) you may waste substantial time repeatedly returning the product for repair. This can be very discouraging to novice users, who may give up on instructional technology altogether if their first experiences are negative.

Rather than give a discount to the early customers who find those problems, companies typically charge a price-premium for newly released products (especially hardware). Moreover, the power/cost ratio of electronic components has been increasing rapidly; a comparable device, two years from now, may cost as much. On the other hand, if you don't buy now, you won't benefit from the product (and you won't be seen as a leader).

Unfortunately, no magic formula exists to determine when to acquire a new product. Purchasing early adds glamor and extra usage; buying later lowers the price and saves headaches. Where, on this continuum, your best investment lies depends on how useful the product is, how much you have to spend, and how high you value initial reliability.

4) "Compatibility" Has Hidden Headaches

Often, you can purchase a device or program that is compatible with a more expensive, name-brand product (e.g. IBM "clones"). At times, this less costly version can be a good buy. However, be wary of potential pitfalls. For example, even though a "compatible" computer will be able to run some of the programs available for the name-brand machine on which it is based, three types of problems are likely:

- some software will not function properly on the compatible machine;
- the name-brand vendor will design its next generation equipment so that your clone will be much less compatible with advanced software;
- should the clone manufacturer out of business (and many do), parts and service will be hard to obtain.

So, how can you protect yourself against some of these risks? When buying compatible hardware, personally test all software you plan to use on that machine to ensure that it will work properly. Do not rely on vendors' lists of compatible software, which may be very inaccurate. Even with this precaution, your plan to upgrade present software to take advantage of newer generations of machines, may be sabotaged clone.

Also, many information technology companies are short-lived should your software or hardware stop functioning, you may find it unrepairable. This is a potential risk not only with clones, but with any product from a vendor other than the huge, established leaders in the field. Buying from an "up and comer"--even if their product is superior--can backfire.

Overall, the decision to purchase compatible hardware or software depends on your individual situation. If you have personally tested the product and are satisfied that it meets your specific needs, are confident of its reliability/repairability and don't plan to upgrade its capabilities, then substantial amounts of money can be saved.

Otherwise, you are better off buying a more expensive name-brand. One warning: if you don't want to purchase a clone, write bidding specifications very carefully. Low bids tend to be based on such "compatible" products.

5) No Single Product (Or Vendor) Is Best For All Situations

Many companies argue that all your equipment should be their brand: hardware, peripheral devices, software. A sales may claim that your specific needs are not essential in choosing equipment, while stressing the capabilities of his product.

These types of claims are false. Power, cost, and ease of use are intrinsic tradeoffs: you can have any two of the three. For example, a powerful product with many functions might be difficult to learn and use, unless the vendor has spent a fortune on development--in which case it will be expensive. Similarly, easy-to-use, low-cost hardware or software may not be functional enough to meet your needs.

In general, you want to buy equipment that is no more powerful than you will eventually need (remember, your demands for sophisticated performance will increase as you gain experience in using the product). Otherwise, you are paying extra money for unused capabilities. Moreover, for the level of power, a product should be as easy to use as possible. Any savings realized from buying a cheaper, but more difficult to master alternative, will likely be spent on extensive training to prevent errors of usage.

When purchasing from a single vendor, you are at the mercy of that company. Every company has both profit leaders, which don't deliver good price/performance, and failures, which work so poorly even rock-bottom prices can't compensate for the hassles. Besides, devices from different manufacturers often work well together--as long as you follow the purchasing strategy discussed earlier--and are likely to cost less as a package than getting similar equipment from one source. Playing the field, therefore, is the safest and most cost-effective approach.

6) Developing Software Is Harder Than You Think

Buying the hardware, then creating your own programs and courseware may be a tempting option: this strategy appears to save money and offers the promise of software customized to your needs. Or, you may be approached by a programmer offering to develop specialized software at you for less cost than tailoring a commercially available package would involve (e.g. building a recordkeeping system customized to your institution, rather than purchasing and altering a generic database which doesn't quite suit your needs). Some might argue that an institution can make money this way, by selling to others what it develops internally.

In general, though, unless you 1) know exactly what software development involves and 2) have a staff with the requisite expertise, this strategy can backfire. Programming takes much longer than expected, even when commercial "authoring" systems are used. A customized software program may not work as claimed or may be to maintain and upgrade. Too, the marketing, distribution, and support involved in selling courseware is substantial; this business is best left to large, experienced corporations with deep pockets.

Creating small-scale applications built from authoring languages can be useful for an some institutions, but (for anything more involved), purchasing commercial off-the-shelf software is a better strategy. If, after considering all these issues, you still believe that your institution should develop its own software, obtain a grant to fund the endeavor. A viable project should be able to attract research money, and in this way you can limit your potential losses.

7) Deciding What To Buy Is Only The Start of the Purchasing Process

From whom does one buy hardware or software? A local dealer will likely charge more than a mail-order distributor; for a large order, the difference can be substantial. On the other hand, retailers provide more rapid repairs and are in no position

to offer this about using what you have purchased; remote wholesalers don't provide that type of service. The more complex or less reliable the product, the better off you are buying locally, unless you have substantial institutional expertise in using that equipment.

Of course, don't assume that someone who works in a computer store knows much about what they are selling. Sales representatives are often ignorant of the fundamental characteristics of their product--though they won't hesitate to say what that they think you'll want to hear.

Here the "Golden Rule" applies: Those That Have The Gold, Make The Rules. If you are planning to purchase a lot of equipment, negotiate for a substantial discount from the individually totaled prices. If you are buying a mixture of hardware, peripherals, and software, ask for a package discount, rather than shop a variety of stores for the cheapest components. The information- technology business is very competitive, and dealers will willingly cut their profits to make a big sale.

If a product with the characteristics you need is not on the market, put together a buying collective. When a large group indicates a commitment to purchase substantial quantities of a new product with certain capabilities, someone quickly finds the time and expertise to develop it. As Chapter 2discusses, being assertive and informed about your needs is vital to speeding the evolution of technologies to fill them.

8) <u>Innovation Requires A Critical Mass</u>

"Think big" when initiating usage of an instructional technology. Small-scale innovation attempts frequently fail because they lack a critical mass of people, equipment, and funding. Perfecting a new approach can be discouraging to an individual or small group; having a lot of people "in the water", sharing the load, really helps. Risks and experiments can be diffused in a coordinated, massive effort, while alternative approaches can be investigated simultaneously to see which works

best.

Even with institution-wide commitment, educational-technology innovations will inevitably fail unless the traditional reward system shifts to encourage their adoption. For example, distance-learning via telecommunications can be cost-effective, only if funding formulas are altered to acknowledge the instructional delivery that has occurred. Furthermore, if promotion and tenure guidelines continue to ignore the value of experimentation with new instructional media, then faculty will choose to invest their time and energy in more traditional pursuits. "Freedom to fail" is vital; missteps are not only inevitable, but valuable in developing new educational paradigms. Innovators should feel free to take risks, without their less successful ventures being seen as foolish errors.

9) Initial Costs Are Just The Tip Of The Iceberg

A frequent error in implementing instructional technology is to invest all available resources in hardware--then find the equipment sitting idle because courseware, training, expendables, maintenance, and upgrades have been neglected. Using technology involves hidden costs up front to convert to a new approached and train users. Expendables (e.g. paper, ribbons, tape, disks), upgrades, and maintenance require continuous outlays, whose impact on the budget cycle must be anticipated. (Service costs can be reduced by developing in-house expertise; in general, maintenance contracts are a poor investment, compared with using the same funds to develop institutional capabilities for minor repairs.)

Typically, only about half of the implementation resources should go for hardware; most institutions make the mistake of underestimating other expenses and allocate as much as ninety percent to equipment purchases. Training is the area most frequently neglected; but the substantial resources involved in preparing people to use a new technology result in increased utilization and productivity. To be effective, new media require

new instructional methods (for example, the disastrous "talking heads" approach to educational television). Without guidance, faculty will use the technology to teach in the same old way, its potential effectiveness being drastically reduced as a result.

10) Technology Changes Individuals and Organizations

The two most common errors in technology assessment are overestimating the speed with which an innovation is adopted, and underestimating its eventual impact. some of the profound organizational shifts that advanced instructional technologies may produce are discussed in the Chapter 2. Institutional plans, practices, policies, and culture must be sufficiently flexible to accommodate these shifts. The management of change often depends on promoting acceptance of an innovation's more indirect effects.

11) No Matter How Much You Buy, You'll Never Have Enough

Smooth implementation of a new instructional technology also will result in a different, unavoidable problem: people will want more! Even with increasing technological power and declining costs, the demands of sophisticated users for expanded functionality will outstrip the budget of any instructional organization. Thus, a byproduct of success is that a new special-interest group will be vigorously lobbying for resources in the budget cycle. Still, if the technology is being used well, demand for the services it produces will generate additional resources for the institution, which is satisfying to all concerned.

12) Wisely Chosen Products Are Never Obsolete

One temptation when purchasing instructional technology is to wait for prices to come down. After all, the performance/cost ratio is increasing rapidly. Why buy now, when next year you can get a more powerful system for less money? If a substantial product upgrade on the horizon, this strategy can makes sense.

In the long-term, however, delay in adopting emerging technologies proves to be a mistaken approach.

If the technology is worth purchasing, the gains in productivity it fosters will more than compensate for funds that might be saved by waiting for the price drop. Moreover, in order to take full advantage of the capabilities people need experience in working with new types of instructional devices. Starting early provides time for this learning, so that when more powerful versions come along, their functionality will be adeptly used. Waiting until it is mature to acquire an instructional device ensures that your institution's students and staff will be behind their peers during and after the period of delay.

In buying a product whose performance/cost ratio is changing rapidly, consider whether the technology is sufficiently general-purpose to have multiple applications. Hardware and software with open-ended capabilities will always be useful, even if they are "obsolete," in the sense that later more powerful, versions have since appeared. When a markedly superior replacement is available, the original devices can be used to train novices or accomplish some other institutional task.

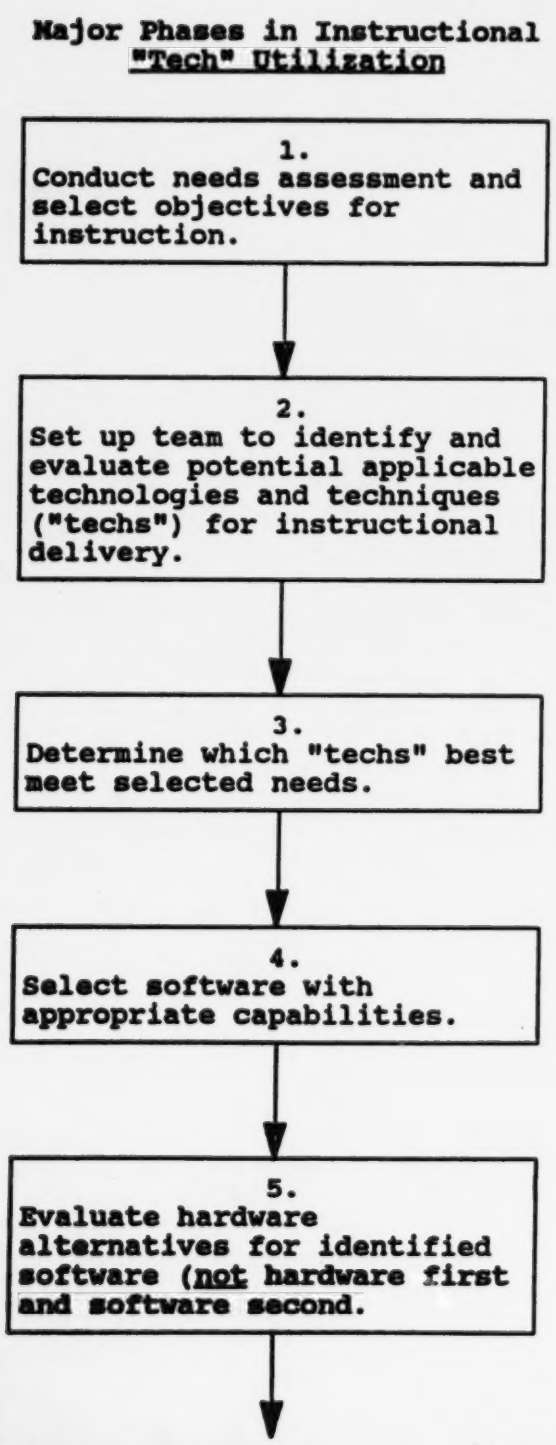
13) <u>Never Taking Risks Guarantees Failure</u> Having read this far, you may feel that the best approach is to ignore emerging instructional technologies for the time being, letting others make the mistakes inevitable in innovation; then to implement these devices when they are mature and the usage strategy is clear. Minimizing risks is always advisable, and on balance people are more likely to criticize you for trying something new in a less-than-perfect way, than to complain because an historically successful pedagogical model is being continued in the face of change.

This strategy, while tempting, guarantees failure. As Chapter 2 indicates, a profound transformation of the American workplace is in progress. Global and regional competition, coupled with a troubled economy and shifting demographics are

producing a rapidly altering environment for occupational education. These "bakers dozen" heuristics attempt to provide a framework for optimal management of uncertainty. Together with the final model and checklist shown below as Exhibit 5.6, they should do much to help you take moderate, but successful, risks in the utilization of new instructional technologies.

EXHIBIT 5.6

MAJOR PHASES IN INSTRUCTIONAL "TECH" UTILIZATION: A CHECKLIST


Major Phases in Instructional "Tech" Utilization
1. Conduct needs assessment and select objectives for instruction.
2. Set up team to identify and evaluate potential applicable technologies and techniques ("techs") for instructional delivery.
3. Determine which "techs" best meet selected needs.
4. Select software with appropriate capabilities.
5. Evaluate hardware alternatives for identified software (not hardware first and software second.

Checklist

For Phases 1-5

____ Include both representative cross-section of typical users and skeptics in team.

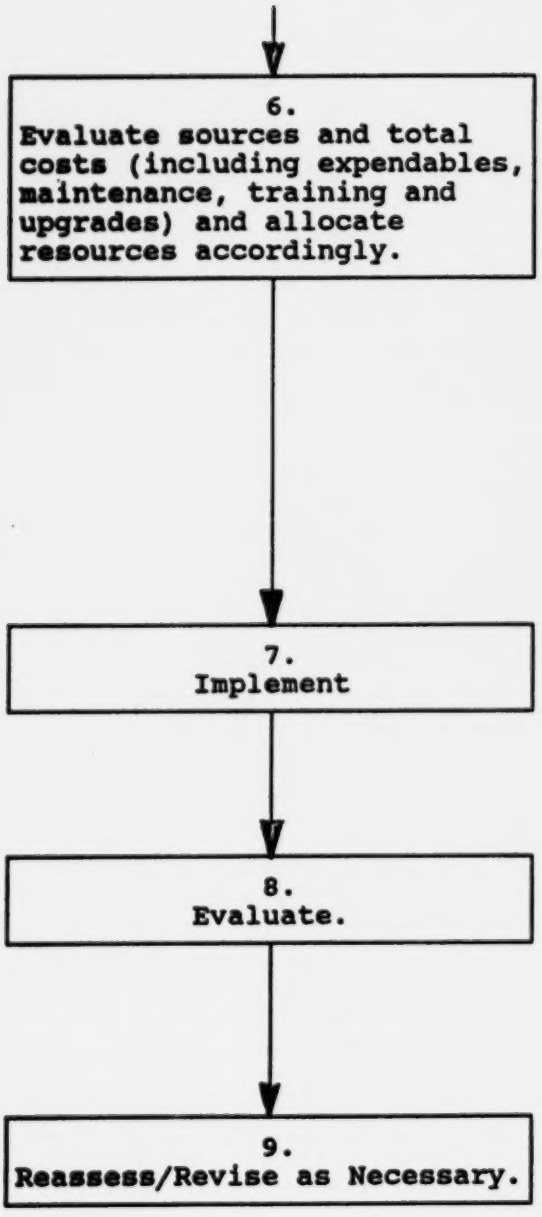
____ Assess carefully being a pioneer: (price-premium, reliability, utility, leadership issues).

____ Choose general-purpose products that will never be obsolete

____ Beware of "vaporware."

____ Be careful in buying "compatible" products (software problems, upgrades, long-term repairability).

EXHIBIT 5.6
CONCLUDED



For Phase 6

___ Think carefully before undertaking major software development projects (delays, cost, reliability, maintainability).

___ Weigh whether to buy locally or mail-order.

___ Don't put all your eggs in one basket (product, vendor).

___ In-house maintenance is cheaper.

For Phase 7-9

___ Think big when innovating (critical mass of users; multiple, alternative implementation strategies)

___ Promote flexibility in institutional plans, policies, practices, and culture (reward system altered to encourage innovation; freedom to fail).

___ Prepare for a new special interest group that "never has enough."

___ Take an appropriate (non-minimal) level of risks.

Conclusion

At a time when regional and national prosperity depend on economic development and workplace evolution, it is essential to shift the instructional model for occupational education to take full advantage of emerging information technologies, as well as the managerial model to take advantage of proactive planning approaches.

Managing stability is naturally more comfortable than facilitating change. And leadership of change has its costs. But in current postsecondary vocational, technical, and adult education, living without risks is living dangerously.

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CHAPTER 6

INTELLIGENCE INFORMATION FOR FUTURE-RESPONSIVE PLANNING AND MANAGEMENT

By:

Christopher J. Dede and O. W. Markley

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CHAPTER 6

INTELLIGENCE INFORMATION

FOR FUTURE-RESPONSIVE PLANNING AND MANAGEMENT

In the previous chapter we introduced a number of methods and guidelines for planning to use emerging technologies in instruction. They are meant to be as practical as possible, given the real-world constraints that most of you live with on a day to day basis.

We now turn to approaches that may seem less practical to some of you. But if your objectives are to proactively influence the environments with which you interact, rather than always responding reactively to changes that impact on you, this chapter should prove quite practical as well. It begins methodologically, and ends with substance.

The methodology is something called the "Strategic Intelligence Cycle," which we ourselves used as an overall method of approach in this research. It will soon be published as part of a chapter on "Information and Social Change" in Information and the Future: A Handbook of Sources and Strategies (Wygant and Markley, 1988), so only the main elements are presented here.

The substantive content is a slightly revised version of the forecast of technological, economic, social and political influences expected to influence economic development and occupational education in Texas, initially prepared by Dr. Dede, for the working paper, "The Future of the Workplace and Education for Work in Texas" (Back, et al., 1987).

The Strategic Intelligence Cycle

We developed this methodology out of necessity, due to the fact that futures research results are so difficult to implement successfully. In doing so we were able to resolve two seemingly opposite problems that are cases in point: 1) most people who are practical "movers and shakers" in managerial or political settings tend to ignore the fact that there is much information

available that could illuminate their actions; 2) most people who are "researchers and analysts" in academic or administrative staff settings tend to ignore that there are a variety of political customs that must be reflected if information is to be effectively used by leaders. What we did is in retrospect quite simple to conceptualize, though it was anything but simple to figure out as we were doing it--we identified and combined essential tools and skills used by three different types of professionals: futures researchers, reference librarians, and political lobbyists.

Unless you are powerful enough to wield czar-like powers, successful influence of a given issue in political settings, at a minimum, requires a reasonably accurate sense of:

- the nature of important cause and effect relationships and cross-cutting factors which influence the issue strongly;
- how the issue and related factors are perceived by important interest groups; and
- the workings of different social institutions and systems in which the issue is embedded.

And if you wish to be proactive, yur inquiry needs to include an exploration of possible, probable, and preferable future states of the issue as well . Naturally it is easier to stipulate such requirements than it is to meet them!

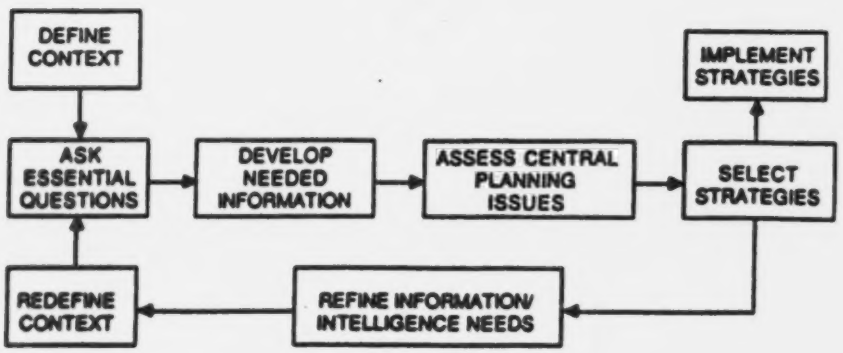
The Strategic Intelligence Cycle represents a practical method of approach through which this type of intelligence information can be developed within realistic time and resource constraints. It is a future-oriented synthesis of the methods and styles that good lobbyists, regional development leaders, and other successful social change agents tend to use in their day to day work, structured in a way that makes for efficient information research.

Overview of the Model

A skeletal overview of the Strategic Intelligence Cycle is presented on Illustration 6.1. Note that in addition to helping select preferred strategies for directly influencing change, the Cycle also emphasizes the **refinement** of information seeking--once it is clear what action-oriented strategies the information is intended to support. Toward this end, the "80-20 rule" is often useful to invoke. Simply stated, it is to: "Go fast and get 80% of the results you want in 20% of the total time you think you have." Then sit down and figure out what to do next. You may or may not want to spend the remaining 80% of the time you budgeted to get the final 20% of accomplishment.

EXHIBIT 6.1

AN OVERVIEW OF THE STRATEGIC INTELLIGENCE CYCLE



Sequenced exposition of the model and Summary Comments

Exhibits 6.2 through 6.5 depict the essential details of each phase of the mode. Experienced practitioners will recognize that the elements shown in each phase, although moderately detailed, represent a vast simplification of matters that are highly complex and often ambiguous. They wer presented, not with the idea that they will rigorously mirror all situations that you are likely to encounter when using them, but with the knowledge that, when combined with the methods presented in Chapter 5, it should be feasible for you to learn whatever you need to adapt them successfully to your own needs.

The organizational capacity to implement the results of these methods, however, doesn't just happen--it must be created. Although the topic of organization development goes beyond what is feasible to treat here, if you are not familiar with this approach, you can read about it in the little book, Strategic Planning for Educators, that was recommended in Chapter 5. Another good source is Flawless Consulting: A Guide to Getting Your Expertise Used, by Peter Block (1981). Additional tools and references are described in Chapter 12 of Information and the Future: A Handbook of Sources and Strategies (Wygant and Markley, in press), where the above description of the Strategic Intelligence Cycle will appear in published form.

EXHIBIT 6.2

The Strategic Intelligence Cycle

Phase 1: Get Underway

A. Define Context of Inquiry
(to ensure clarity and alignment of key purposes and results):

1. What are the nature and needs of the target audience and outcomes that are desired ?
2. What are the resources and constraints that will shape what is feasible to attempt ?
3. What are the criteria through which to judge effectiveness ?

B. Explore Essential Questions
(to identify and understand key planning issues):

1. What is the likely future of "X" ?
2. What is the preferred/feared future of "X" ?
3. What factors have previously controlled or strongly influenced what happens to "X" ?
4. Who are the people and institutions whose behaviors will most strongly influence "X" ? ("influentials")
5. Who has a strong stake in the outcome of "X" ? ("stakeholders")
6. What trends, issues, policies or other forces may be emerging that may strongly impact on "X" or our ability to influence "X" ? ("cross impacts")
7. Who is the most knowledgeable about the above questions ? ("knowledgeables")

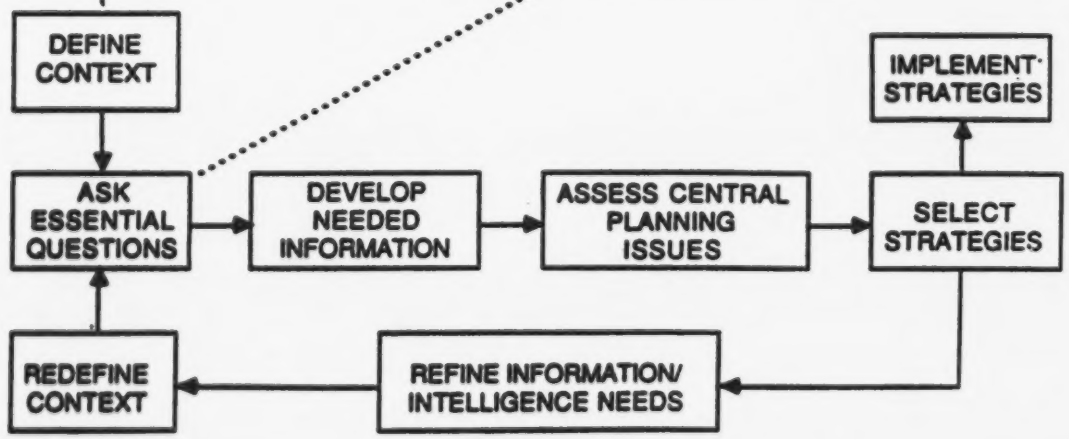


EXHIBIT 6.3

The Strategic Intelligence Cycle

Phase 2: Develop a Change Oriented Information Framework

(to organize and manage needed information)

a. Historical Context of "X"

- Past writings of importance
- Legislative and/or judicial history
- Other historical factors of importance (e.g., key vested interests)

b. Key Actors and Agenda

- Influentials
- Stakeholders
- Knowledgeables

c. Key types of Information

- Documents
- Contacts
- Messages

d. Alternative Approaches

- Ideologies
- Schools of thought
- Policy proposals
- Possible coalitions

e. Things to Monitor

- Media coverage
- Movement in key policy proposals
- Changes in "story" of key actors
- Changes in other key factors

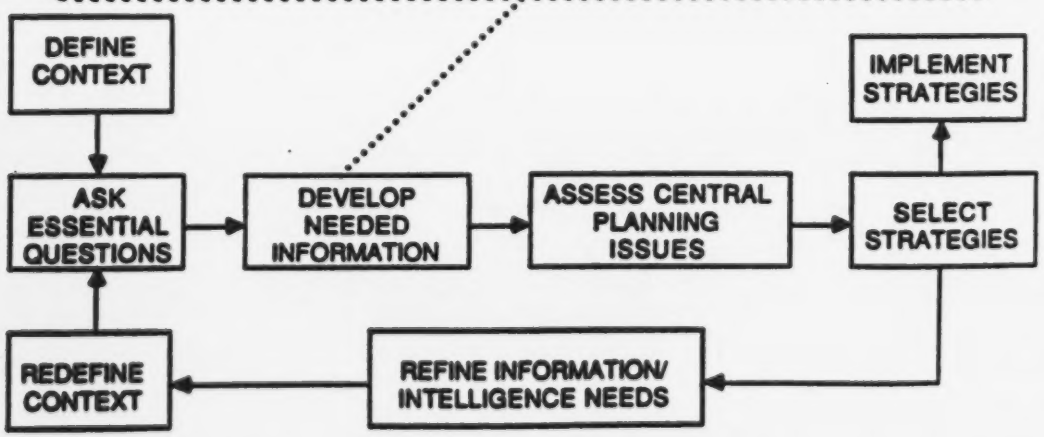


EXHIBIT 6.4

The Strategic Intelligence Cycle

PHASE 3. Assess Central Planning Issues
(to develop appropriate strategies)

a. Identify critical factors, obstacles and incentives

What factors must be influenced if the future of "X" is to become what we want it to be ?

What obstacles are likely to prevent us from influencing things as we would like ?

What incentives can be brought to bear to overcome obstacles ?

b. Estimate critical timing relationships

Are any key factors likely to become "acute" and require a crisis-reaction strategy that would be less effective or more costly than a proactive response ?

What is the likely sequence and timing of events that will most strongly influence "X" assuming that we do not intervene "proactively" ?

c. Identify Probable and Desirable Roles

Who are the relevant players ?

What is the range of roles that each is likely to play, assuming either that we do, or that we do not act proactively ?

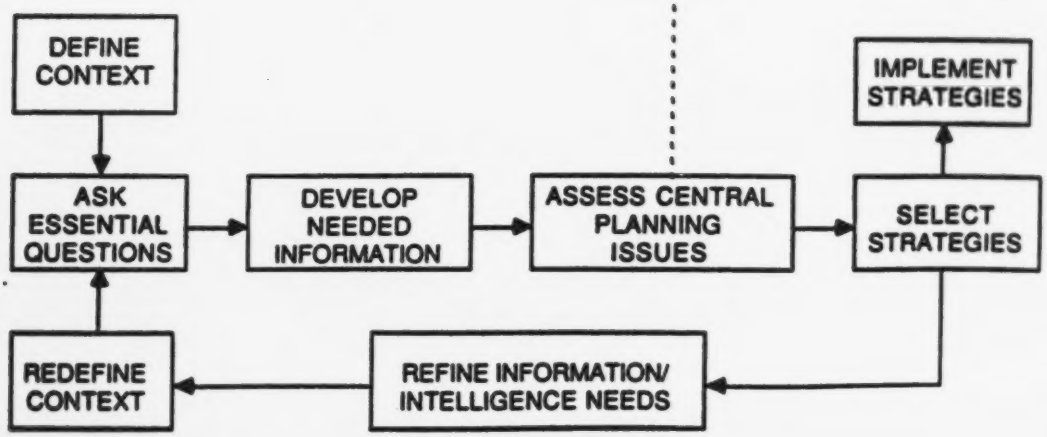


EXHIBIT 6.5

The Strategic Intelligence Cycle

Phase 4. Select Strategies
(to successfully influence the future of "X")

- Take direct action
- Engage in single-issue lobbying
- Collaborate with coalition networks to develop a broad range of proactive agenda
- Publicize selected issues or points of view
- Develop needed information to answer critical questions

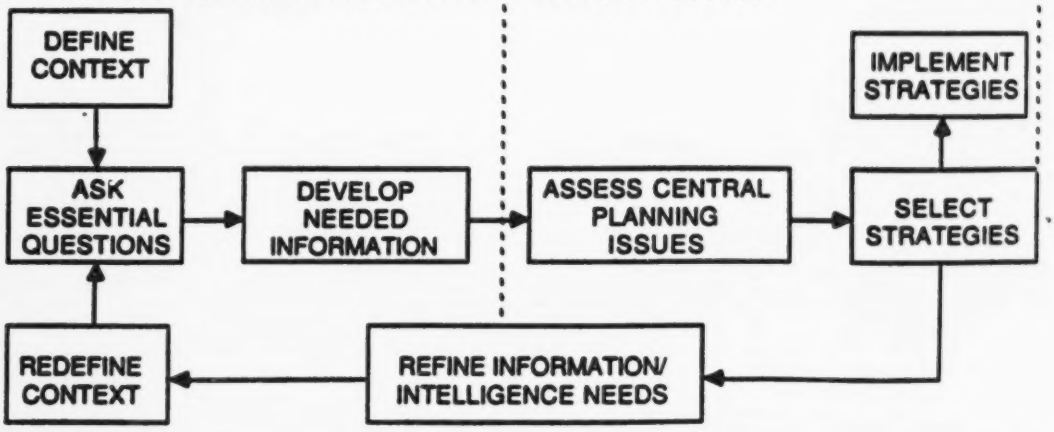
Phase 5. Refine Information/ Intelligence Needs

a. Type of Information

- Statistical data
- Authoritative reports
- Knowledgeable experts

b. Immediacy of Source

- Primary sources (personal communication or original writing)
- Secondary Sources (popular literature, news media, trade/professional working papers, etc.
- Tertiary sources (summaries, abstracts, indexes, etc.)



Factors Influencing Economic Development and Occupational Education in Texas

Even though our use of the Strategic Intelligence Cycle in the research reported here was only slightly deeper than the "80/20" level described above, it is not feasible to report on all factors of significance that we identified. Instead we have chosen to emphasize items most readers could not easily find out about for themselves.

Although there are a number of published treatments on "environmental" factors that planners should consider, none we found focused tightly enough on implications for economic development and occupational education in Texas. Therefore, we synthesized our own forecast, and structured it according to two underlying dimensions: 1) topic (technological, economic, social and political); and 2) probability/time frame (highly probable/almost certain, reasonably probable, conceivable/uncertain, and long range). This provides a means by which planners can prepare for a wide spectrum of possible events, choosing the time horizon and the degree of likelihood they wish to address.

This forecast, which begins on the next page, is printed in the Times type face to make it distinct from the rest of the chapter. Two different fonts have been used to facilitate scanning: the most important material is presented in Times 12; additional illustratins of these points and greater levels of detail are printed below these in Times 10.

As noted earlier, the first version of this forecast was done for a 1987 Coordinating Board Working Paper (Back, et al., 1987). This final version includes updated and addtional material. The fundamental themes remained constant, however.

TECHNOLOGICAL FACTORS.

Highly Probable/Almost Certain

• *the emergence of very powerful tools for manipulating information*--the price of computer and telecommunications power is dropping, while performance is increasing. Coupled with advances in artificial intelligence, the emerging universality of digital code is creating a synthesis between computer and telecommunications devices that will result in new types of information products. These evolving tools offer corporations access both to greater amounts of information and to powerful methods for extracting knowledge and wisdom from this data. This has implications for product development, process innovation, office and factory automation, and institutional management strategies. Businesses based on information are a growing proportion of the Texas economy, but the state is still building on a predominantly preindustrial and early industrial occupational base. Its proportion of jobs in agriculture and construction rank well above the national average; transport, retail, finance, and personal services are at about the U.S. average; professional services, public administration, and manufacturing are below the median proportion nationwide. The fastest growing sector of the state economy is the information sector; for example, by 1990, expansion of the printing, publications, and communications industries is expected to generate an additional $5 billion in annual output, $1.4 billion in annual earnings, and 71,000 new jobs.

• *advances in biotechnology*--types of innovations on the immediate horizon include:

--vaccines to protect against viral diseases
--improved methods for organ transplantation
--techniques for curing hereditary diseases (such as hemophilia)
--crops which make their own fertilizer
--plants which thrive on land presently considered barren because of its aridity or salinity
--ways to improve the growth and health of farm animals
--low-cost renewable fuels (including methane, hydrogen gas, alcohols)
--new sources of raw materials for the manufacture of plastics, paints, artificial fibers, and adhesives
--microbes which can aid in ore extraction
--improved systems for controlling pollution

Texas, with its agricultural heritage and the Houston medical complex, is well positioned to become a leader in these technologies.

• *the emergence of computer integrated manufacturing (CIM)*--computer assisted design/computer assisted manufacturing (CAD/CAM) is evolving into CIM, which will link all aspects of the production and distribution of goods. Occupational roles involving design, development, manufacture, inventory, service, vending, financing, marketing, managing, and personnel will all be affected, with rapid shifts in skills needed. Because of gains in productivity associated with CIM, by the year 2000, less than 10% of the American workforce will be involved in manufacturing (half of 1980 levels), and these remaining jobs will require sophisticated skills.

• *the evolution of office automation*--word processors, data bases, and spreadsheets are only early stages in the development of advanced office environments. Many shifts in occupational roles are expected as workstation

interconnections, customized decision templates for each job, and expert systems for standardized tasks transform current information management approaches. Already, many middle management jobs are disappearing as information technologies assume the role of filtering and synthesizing operational information for high level decision makers.

• *elimination of some service jobs*--just as large computers eliminated many clerical positions, so the next generation of information technologies may be used by service providers to cut costs. For example, bank machines are reducing the number of tellers needed; telebanking may eliminate some branch offices. Home shopping via the television could have a similar effect on many retail sales positions. In Houston, for example, one UHF station has already converted to a "Home Shopping Network."

Reasonably Probable

• *new capabilities for instructional technologies*--individualization, intermixing, increased quality, cost decreases, and multiple options are all increasing each year.

Individualization

The evolution of narrowcasting, interactive videodisc, and videotex all indicate rapidly growing capabilities for tailoring information to user needs. Over time, the passive, spectator role for students will be increasingly replaced by opportunities for directed response to queries, for exploration via simulations, and for creative interchange through artificial intelligence software. Simultaneously, networks capable of interconnecting all users and transmitting huge amounts of information among them will gradually appear.

Intermixing

The growing shift to use of digital code will allow the increasing synthesis of data, video, audio, and software signals. The "tower of Babel" problems now prevalent with incompatible devices will gradually diminish, and telecommunications will become the unifying medium for all information technologies. Combining the attributes of the computer, television, radio, videodisc, copier, telephone, and printing press will produce new tools with great power for facilitating learning. Because of this synthesis of technologies, the struggle for control of the information economy will intensify among corporations marketing computers, telecommunications devices, and radio/television/print media.

Quality

Capabilities never before possible are becoming economically feasible because of advances in processing power, memory storage, and delivery systems. Very high resolution; freeze-frame, zoom, and multiple images; freedom from electromagnetic interference; and portability all will combine to enhance the power of the medium to educate students. Just as "talkies," stereo, and color expanded the experience of users, so will these new attributes contribute to the motivational and instructional force of programming.

Cost Decreases

In contrast to most technologies, information tools have become less expensive year by year for equivalent power. For example, the amount of information which can be processed by computers has been doubling every two years per unit cost and time for the past four decades, and this trend will likely continue until the year 2000. Fiber optic cable is cheaper than copper cable, smaller, lighter, more reliable and secure, immune to electromagnetic interference, and has much greater capacity. Optical scanners which two years ago cost $2000 now retail for

$7. Because of these and other technical advances, the proportion of the population which can afford access to high quality information services is steadily expanding.

Multiple Options

The range of technologies by which users can choose to receive a service is growing rapidly. For example, in the near future educational programming will be deliverable by broadcast, one-way cable, two-way cable, direct broadcast satellite, instructional television fixed service (ITFS), low power television, high definition television (HDTV), digital television, videotape, digital optical disc, and videodisc. Manufacturers, suppliers of services, and consumers alike are confused by this plethora of alternatives and uncertain as to how to invest their resources. An "ecology" of information technologies is emerging, in which each tool has its own "niche" determined in part by cost, attributes, installed base, and the availability of quality programming. The size of the total "information ecosystem" is growing, as expenditures on information technologies continue to rise faster than overall personal consumption. The shape of each niche is shifting, both as new technologies with greater capabilities or lower costs cut into the market share of older technologies and as the boundaries between technologies increasingly blur.

• *a new type of content in the work-related curriculum*--types of knowledge and skills previously too expensive to be included can be taught on a cost-effective basis using the new information technologies. Words, symbols, and line drawings are cheap and powerful; historically, postsecondary education has tended to emphasize subjects which can be taught completely in this manner. A difficulty which such an approach poses is that words and symbols are good for teaching descriptive and declarative knowledge, but not so good for conveying complex procedural skills such as laboratory procedures, diagnostic strategies, advanced writing, equipment troubleshooting, and instrumentation usage. Historically, occupational training has been hampered by the high cost of instruction for complex, higher order procedural skills, but technological simulation provides a relatively inexpensive and manageable approach to teaching this type of knowledge in an outcome-oriented manner. For example, a single Compact Disk/Read Only Memory (CD-ROM) can now hold as much information as about 1500 floppy disks, 15 four drawer file cabinets, or 500 books. Any program, file, or document on the disk can be accessed in less than three seconds. The CD players costs around $600 and attach to standard microcomputers; the disks cost about $5 each to produce in quantity. The expense to publish a comparable amount of information on paper or floppy disks is approximately $5000, a cost advantage of approximately 1000:1 for CDs (this is equivalent to printing a typical novel for about a penny a copy). In addition, optical disks offer the advantages of compactness, portability, electronic cross-referencing, and rapid access. For advanced technological simulations, their ability to store text, program code, digitized voice, graphics, music, and images on a single disc is very useful.

Conceivable/Uncertain

• *"learning-while-doing" as a major training method*--workplace tools may increasingly include intelligent devices that act as job performance aids and simultaneously audit user skills to allow credit for real world accomplishments. Distance delivery of interactive educational services through sophisticated telecommunications networks may alter the typical "classroom" experience. Postsecondary educational institutions will need to develop greater flexibility in its systems of instruction and evaluation when knowledge no longer comes packaged only in three credit chunks. Many corporations are using the new information technologies as

a major part of their retraining efforts, and experiments with technological delivery of non-credit continuing lifelong learning are being funded by the Kellogg Foundation, among others.

• *the emergence of large scale "information utilities"*--people need ways quickly to filter information from data, knowledge from information, wisdom from knowledge. Essential to this process are two factors: access to a wide variety of data, and tools/training for screening out "meaning" from "noise." An information utility would supply both of these commodities on a decentralized basis to clients (in this case, to postsecondary vocational, technical, and adult education). A recent study indicates that Texans are heavy media consumers and that the proportion of individual use grows with increased education.

• *new types of instructional devices*--"intelligent" tools which synthesize computer and telecommunications technologies. These open up new methods of teaching, including Socratic machine-based tutors, simulations with embedded coaches, elaborate empowering environments, and surrogate travel. Because of breakthroughs in storage devices, each student will have inexpensive access to massive amounts of data via interactive networks and optical discs. In addition, these devices can unobtrusively and cheaply measure key variables such as student time on task, response time to questions, percentage of errors in answering items, pattern of mistakes made, and tutoring sequences chosen (a cognitive "audit trail"). As a result, information previously unobtainable about individual performance can be garnered as a by-product of instruction without elaborate human recordkeeping. Further, as instructional devices are tailored to learner response and alternative pedagogical modalities tested, the success or failure of different approaches can provide important insights into the basic nature of higher order adult learning.

Long Range

• *new breakthroughs in materials technology,* including near-room temperature superconductivity which have strong applications in computers, electrical machinery, electrical power distribution, and transportation--to name a few; and *"nano-technology"* (meaning technology that operates in the physical size domain of a nanometer -- .000000001 meter), envisioned to include the capability to design and shape the atomic structure of new molecules on an "atom-by-atom" basis, and molecular level automated assembly processes.

• *partnerships between people and "intelligent" tools*--human beings and information devices have complementary cognitive skills and can work together to accomplish tasks more effectively than either the person or an automated device could working alone. The strength of the intelligent tool is solving sophisticated, but standardized problems; the human role in this cognitive partnership becomes primarily problem recognition and solving unusual problems. This role requires higher order thinking skills such as creativity, flexibility, decision making given incomplete data, complex pattern recognition, information evaluation and synthesis, and holistic thinking. Developing a workforce with these capabilities implies a new definition of human intelligence, as the old definition increasingly becomes the function of information tools. This has major implications both for the preparation of new workers and for retraining the existing workforce, as the skills needed to perform an occupational role (or even the role itself) change rapidly. Texas postsecondary vocational, technical, and adult education system is asked to assume much of the regional responsibility for developing and conveying this evolving conception of "intelligence."

• *a differentiation between "training" and "education"*--with each having a different set of instructional methods. One way of conceptualizing the issue of what part of the curriculum is best adapted to technological delivery is to classify material which has a limited range of right answers to questions as "training;" in contrast, "education" would be the portion of the curriculum in which a question could have many possible right answers, or the correct answer is not known, or the question is not meaningful in terms of "right" and "wrong" responses. The "training" portion of the postsecondary vocational, technical, and adult curriculum may eventually be delivered in large part by "intelligent" teaching devices, particularly for introductory subject matter with large student populations. Training is best done in an individualized and interactive manner, and artificial intelligence based information technologies can recognize a limited range of right answers and can provide guidance on how to correct common mistakes. These instructional devices will not provide a comparable experience to a skilled faculty member working one-on-one, but are becoming increasingly effective and cost-efficient compared to an instructor attempting to train twenty to thirty students simultaneously. By using a combination of human instructors and intelligent tools, postsecondary institutions can more effectively accomplish both training and education: instructional devices providing a common foundation of basic skills and knowledge, and teachers working with information tools to build a mastery of complex occupational concepts (such as skills in the new definition of human intelligence) on this foundation.

ECONOMIC FACTORS.

Highly Probable/Almost Certain

• *changing nature of employment*--a continuing shift from agriculture to manufacturing and service-oriented, employment, with technology-driven reductions in the skill levels required in many jobs ("de-skilling") and increasing skill levels in others.

• *growing global interdependence of Texas corporations*-- an expanding proportion of their revenues will come from international sales, competition from foreign firms will continue to erode their domestic markets, and their financial strategy will be increasingly linked to world debt fluctuations. For example, Mexico owes U.S. banks approximately $25 billion; of the 17 largest American banks, 13 have more than half of their net worth in Mexican loans. Texas banks have heavy liabilities in Third World debts (as well as energy related loans, whose stability is linked to the Mideast situation).

• *increased uncertainty about short term economic trends*--the complexity of the world, national, and local factors which combine to determine regional prosperity makes long range planning very difficult. Warring coalitions of economists, politicians, business leaders, and educators disagree on the direction the American economy should evolve. For example, some argue for protectionist legislation and a resurgence of traditional industrial approaches, others see massive automation to reduce labor costs as the key strategy, and a growing group believes that the U.S. should transform beyond an industrial economy to a production system based on value added manipulation of knowledge. Each of these alternatives has different implications for the types and mix of occupational skills that postsecondary vocational, technical, and adult education should convey.

• *increasing national emphasis on regaining economic competitiveness*--federal antitrust, depreciation, investment, and tax codes may be dramatically altered. Texas will be seen as a key component in any U.S. economic redevelopment strategy, since it contains three of the ten biggest cities, the third most active port, most of the border with Mexico, much of the nation's refining capacity, one of the country's largest medical complexes, and numerous other crucial resources.

• *other significant policy changes* at the national level to deal with the national debt, negative balance of payments, and job exportation.

Three Illustrative Scenarios

• *a knowledge-based workplace as America's economic development strategy*--the economy shifts from standardized production to customized goods based on the individual needs of consumers (like having a tailor make all your clothes as inexpensively as buying them off the rack). A substantial global demand for made-to-measure products exists, and (unlike low wage rate or cheap raw materials cost industries) the United States is well placed to dominate this market because our highly educated workforce is the ideal prerequisite for person/tool partnerships. The most rapidly expanding portion of the Texas economy is information based jobs, which increased 93% in the state between 1973 and 1983 compared to 36% nationwide. The information technology subsector of information based jobs grew most rapidly, followed by information services, media, information trade, and research & development. (Many of these jobs were not advanced occupational positions, however.)

• *protectionist trade policies as America's economic development strategy*--to restrict international competition and preserve current domestic industries. The United States may seek to retain its present occupational profile as long as possible by suppressing imports of steel, automobiles, and other products in which we have a substantial historic investment. Forced retraining and unemployment through obsolescence would be minimized. While new, high technology sectors would slowly develop, their evolution would be retarded by counter-protectionist tactics from other nations and by the massive drain of investment capital needed to sustain our aging traditional industries.

• *a "superindustrial" workplace as America's economic development strategy*--the nation may seek to offset its greater costs for energy, materials, interest and inflation by minimizing human labor in making high quality standardized goods (such as cars and refrigerators). As a result, many middle level occupations would largely disappear (in recent years, other than when an entire employer has gone out of business, the majority of layoffs have been intermediate level positions). A few engineers, scientists, and bureaucrats would coordinate the superindustrial economy, while most people would either hold low wage service jobs (waiter, sales clerk, janitor) or be unemployed. For example, last year almost 60% of the new jobs in the American economy had starting salaries of less than $7000 per year (in the late 1970's, less than 20% of new jobs had such a low starting salary).

In Texas, competing groups are pushing variants of these alternative development strategies for this region. Which coalition will prevail is unclear.

• *an overall loss in purchasing power for potential students*--in constant dollars, median family income is six percent less than in 1973, and "discretionary" income (the amount left over after mandatory expenditures such as taxes, housing, food, etc.) is down even more sharply. Also, loss of domestic market share to foreign competition has cost many U.S. jobs, so that structural unemployment now averages seven percent even in times of relative prosperity. Since 1980, the interest on the federal debt has increased to over $1000 per person per year (and will reach $2300 per year by 1990 if equivalent deficits continue). Nationally, personal debt has risen over three times faster than income during the last two years, and the ratio of personal debt to income has set new records for the last five years. All these forces impact on the amount of funding Americans will spend on educational services. Texas ranked only 34th among the states in money spent per student on precollege education in 1985; its average teacher salary was 24th among the states. Currently, Texas ranks 47th in the nation in the Standardized Aptitude Test scores of its teacher certification applicants. This low expenditure level has its price; the state is 42nd in the percentage of its youth who graduate from high school--almost one in three Texas ninth graders do not receive a high school diploma.

Reasonably Probable

• *economic austerity policies* designed to reduce the governmental and personal level of spending, although politically unpopular, are not unlikely and would significantly influence economic development and education.

• *continuous vocational/technical education becomes a key corporate strategy*--skilled labor and proprietary technologies are recognized as the most powerful barriers to foreign competition. American firms invest heavily in occupational training as a source of sophisticated workers, who can develop and implement complex technological processes that reestablish this country's preeminence in advanced industrial products. Workers currently employed will still be over ninety percent of the U.S. labor force for most of the next decade, so retraining this group to the needs of a knowledge-based economy is vital. Internationally, America has dropped from second to seventh place in the level of skilled workers, in part because of an aging population. American firms spend an average of only $300 per worker annually on training compared to $3300 per employee on capital investment. Estimates of "functional illiteracy" in our society range from twenty-five million to forty-five million people: the equivalent of the combined populations of New York, New Jersey, Pennsylvania, Delaware, and Maryland. Providing access to college and university services is not enough to resolve these problems: less than four percent of employees eligible for company-sponsored tuition assistance use these benefits. Texas postsecondary vocational, technical, and adult education system may be seen as a resource for improving corporate training.

• *major short term U.S. economic difficulties*--a negative balance of trade, growing federal deficits, and mounting Third World debts are destabilizing the U.S. position as "global banker." Additional American economic problems include $250 billion dollars of farm debt; defaults on energy and real estate loans in states whose economies are based on oil prices; $1 trillion of public physical infrastructure replacement (highways, bridges, dams, sewers) needed over the next decade, with proportionate capital equipment replacements necessary in the private sector; a very high real cost of money (interest rate minus inflation rate); and a rising tradeoff between the level of inflation and the level of structural unemployment. The U.S. is the most unequal in its distribution of wealth among the developed nations, and

these trends are creating a situation of substantial disparities in income and corresponding concerns about crime and unrest. In Texas, the September, 1986 state budget deficit of $3.5 billion was the largest in U.S. history.

Conceivable/Uncertain

• *shifts in workers' affective and motivational skills*--new institutional systems for allocating power and responsibility may emerge in the workplace over the next decade, as patterns of authority shift from hierarchical structures to more decentralized, "bottom up" approaches. The knowledge based economy and emerging intelligent tools may require rapidly evolving institutional policies. Cultural forces coupled with dehumanized working conditions have weakened the Puritan ethic and the desire to perform quality work. Developing a new control mechanism that combines the speed and accountability of hierarchical authority with the democracy and shared knowledge of a more decentralized system will require a workforce adept at cooperation, compromise, and group decision making. Texas postsecondary vocational, technical, and adult education may be asked to develop affective characteristics which facilitate these skills, as well as to instill a greater interest in accomplishment as a source of self-worth.

• *work-related education a less attractive investment*--because of discrimination and underemployment. Some economists and educators argue that, while the proliferation of high technology industries will create some professional and technical jobs, on balance advanced technology is likely to reduce the skill requirements for most jobs in the U.S. economy. If true, this would further erode the potential financial return from investing in postsecondary occupational training. Women as a group have much lower earnings than men; a college educated woman earns approximately the same amount, on average, as a white male who has only completed elementary school. This disparity is partially due to discriminatory forces in high status occupations, but also reflects the fact that women workers tend to be clustered in a few work roles (primarily clerical, nursing, and teaching jobs) which are not highly salaried. From an economic point of view, especially given the current troubled U.S. economy, women have less to gain from increased education than men do; similar arguments can be made for minority groups. Also, underemployment is increasing, as the number of educated persons has grown more quickly than the number of jobs which require academic training (one in four workers today has a college degree). As a result, postsecondary educational experiences have rapidly become no guarantee of a high salary; as early as 1970-75, the wages for high school graduates ages 25-34 increased 32%, while those of comparable college graduates rose only 19%. Over the last fifteen years, the proportion of male college graduates who have had to settle for non-professional, non-managerial jobs has increased three-fold (for women, four-fold).

Long Range

• *a new model of postsecondary vocational, technical, and adult education*--in addition to serving the needs of students entering the workplace, postsecondary institutions aid in massive reeducation of adult workers. The curriculum shifts from performance fluency in "training" to developing the generic higher order skills in the new definition of intelligence. Evaluation measures for achievement and success are reconceptualized. An emphasis on other cultures and foreign languages is essential in preparing students for a workplace based on global markets. Faculty/tool partnerships in instruction are important in giving pupils experience and models for using information devices in problem solving. An alternative, technology-based model of instruction in postsecondary vocational, technical, and

adult education evolves. Texas citizens would perceive regional prosperity as strongly linked to investment in sophisticated occupational training systems.

SOCIAL FACTORS.

Highly Probable/Almost Certain

• *growing emphasis on cultural and linguistic diversity in the workplace*--to sell products in other countries, American corporations need personnel who can effectively communicate in languages other than English. The ability to work flexibly within another cultural framework is also vital, as many countries across the world have radically different patterns of thought and belief than Americans. Texas has major resources of cultural and linguistic diversity, as discussed immediately below.

• *growing diversity in the American population*--by the year 2000, one of every three Americans will be non-white. Hispanic population growth is the highest of all groups; by the end of the 1980's, Hispanics will be the single largest minority group in the country. This population is concentrated; sixty percent of all Hispanics live in three states (California, New York, Texas). Minorities constitute the majority of school enrollment in twenty-three of the twenty-five largest cities in the U.S. Black and Hispanic participation in education declines dramatically at higher levels, and the majority of the few Blacks and Hispanics in higher education are enrolled at community colleges or predominantly minority institutions. Moreover, the proportion of Black and Hispanic high school graduates who go on to college is significantly decreasing. In Texas, minority populations comprise 35% of its population base and 46% of its youth. By 2010, minorities will be close to 50% of Texas total population. The state ranks 17th in its percentage of Black population, 2nd in Hispanic, and 5th in Asian American. A disproportionately high number of Asian Americans are enrolled in advanced higher education in Texas; a disproportionately low number of Blacks and Hispanics are enrolled.

• *almost half the poor in America now are children*--nationally, twenty-two percent of children under eighteen are poor. The impoverishment of experience that necessarily comes with low family income may handicap many of these children as workers or students. In Texas, the average 1985 welfare payment for needy mothers and children was $57 a month (46th among the states). Moreover, only 20% of single mothers in Texas are receiving assistance (compared to 80% in Pennsylvania). In Houston, one in five Black families in Houston had an income below the poverty level in 1985 (compared to one in twenty for whites). In 1983, twenty-seven percent of 3 and 4 year olds in Texas were below the poverty level. These children will be part of the postsecondary vocational, technical, and adult population in less than two decades.

• *the "typical" childhood is changing*--in 1955, sixty percent of the households in the U.S. had a working father, a housewife mother, and two or more school age children. In 1980, only eleven percent of homes fit that profile; by 1985, only seven percent. Separation, divorce, and remarriage are all increasing; if current trends continue, fifty-nine percent of the children born in 1983 will live with a single parent by age 18. In Texas, there are over five hundred divorces for every one thousand marriages.

• *troubled early childhood experiences*--American white teenage females are twice as likely to give birth outside of marriage as any other country studied; every day,

forty U.S. teenage girls have their third child. Since very young mothers tend to have premature babies with low birth weights (a good predictor of major learning difficulties when the child gets to school), almost 700,000 babies of the 3.3 million born annually in the U.S. are "high risk" educationally. In 1985, one of every three babies in Texas was born out of wedlock (over 77% of all Black births). Texas ranks 14th among all states and the District of Columbia in its proportion of teenage births to all births. More than 16% of the babies born in Houston in 1984 belonged to mothers between the ages of ten and nineteen.

Reasonably Probable

• *declining postsecondary enrollments of traditional age students*--the "baby bust" generation of the 1960's is now entering colleges and universities; during the next decade, this will significantly affect attendance, since almost half of the total enrollment in higher education (and three-fifths of the undergraduate enrollment) comes from this age cohort. Between 1983 and 1993, the population aged 18-24 in the U.S. will decrease by 5.5 million, a decline of 18%. This decrease follows a long period of growth caused by the "baby boom" after World War II; for example, the 18-24 age cohort increased by 22 percent between 1970 and 1983.

• *growing numbers of older postsecondary students*--from 1983-1993, the number of people age 35 to 44 will increase 37 percent, and the proportion of adults seeking occupational training may grow. For example, because of economic shifts, needs for career mobility, and rapid technological developments affecting job skills, many workers will seek formal vocational/technical services (one-third of American adults have changed occupations in the last five years). A "promotion squeeze" may add to the amount of career mobility: in the 1960's, many young people were entering a workforce with relatively few older personnel available to act as managers and supervisors. As a result of "many Indians, few chiefs," a large proportion of these older workers had high level job roles, titles, and salaries. Now the opposite is true: the "baby boomers" comprise a large senior workforce population, and few younger workers are being hired. The opportunities for meaningful promotion are much more restricted, potentially leading to some degree of job dissatisfaction. Current estimates are that, by 1992, half of all college students will be over 25, and twenty percent will be over 35.

Conceivable/Uncertain

• *an increasingly metropolitan Texas* --almost 80% of its citizens now reside in twenty-six metropolitan areas (the largest number of any state). Unlike almost all metropolitan areas in the U.S., many Texas cities have expanded both their core population and their suburbs. Houston grew over 45% in the 1970's; Dallas, over 25%. Texas cities' core and suburbs are strongly divided along ethnic and socioeconomic lines: 14% of Houston Blacks live in the suburbs, compared to 69% in Miami and 46% in Los Angeles and Atlanta.

• *a rise in Texans' anti-intellectualism and a backlash against new information technologies*--less than 17% of Texans are college graduates (23rd among the states). The educated population is distributed very unevenly: Austin has one of the highest rates of doctoral holders in the nation, while other areas of the state are very low on this measure. Texans are seldom in the middle: they tend to be rich or poor,

well educated or with little schooling. A recent study indicates that Texas workers who are lower paid and without much education have mixed feelings about the occupational and social influx of information technology.

Long Range

• *a shift in the characteristics of the American workforce*--the "baby boom" age cohort moves into the ranks of senior workers and experiences a "promotion squeeze;" members of the smaller "baby bust" generation have multiple potential employers competing for their services; and, due to changes in the "typical" childhood, younger workers are significantly different in their personality, culture, and experience from past generations. The goals, content, and methods of Texas postsecondary vocational, technical, and adult education alter in response to this changing clientele.

POLITICAL FACTORS.

Highly Probable/Almost Certain

• *growing concerns about substance abuse, violence and other anti-social behaviors*--which are seen as degrading both the economic competitiveness of the nation, and general quality of life.

• *increasing incidence of, and concern about litigation*, and rising costs of liability insurance affecting all sectors of society, small towns are particularly vulnerable.

• *growing political power of the elderly*--the proportion of the U.S. population over sixty-five in age is increasing, while the fraction under age twenty is shrinking. Senior citizens (17% of the population) have very high voter participation rates (40-45% of the turnout in elections); in contrast, 17% of potential voters under age thirty participated in the 1986 elections. Older people tend to be conservative in their political philosophy and more concerned about medical and social services for their age cohort than about education or economic development. In Texas, the state population is relatively young (less than ten percent of its citizens over 65) because of recent high immigration rates. (Even with all the recent immigration, Texas still ranks only 25th in the percentage of its citizens born in another state--almost seventy percent of its inhabitants are natives.) Thirty percent of its population is under 18; the state's median age is 28 years old.

• *a rising "social dependency" ratio*-- this reflects the proportion of non-working people (elderly, children, ill, unemployed) to workers and is a measure of how much income must be transferred to keep the society stable. For example, in the 1940's, each retired person on social security was supported by over twenty workers; by the early part of the twenty-first century, this ratio will be less than one to four. High social dependency ratios create a political emphasis on creating jobs and increasing economic prosperity.

• *a strongly public Texas higher education system*--of the 156 postsecondary institutions in Texas, 98 are public and only 13 are independent/non-profit.

• *barriers to innovation in postsecondary educational practices* --the adage that "it is easier to move a cemetery than to change a university" may well be true. Even given massive external forces promoting the development of a technology-based model

for higher education, building a market for a new approach will be challenging. Historically, the use of information technologies in universities has been restricted by three factors (other than the very limited capabilities these devices have had in the past). Attempts to innovate with information technology have been less successful than expected because:

1) Faculty were often not trained to use new instructional devices; as a result, educational applications were unsophisticated and sometimes counterproductive.

2) A "critical mass" of faculty to prepare and exchange courseware was not reached; moreover, a level of capital investment sufficient to provide enough hardware access for students was not attained.

3) Academic reward systems were not geared to encouraging faculty use of technology; institutional funding formulas were not directed toward promoting productivity through telecommunications.

All three of these remain potential traps for universities seeking to pioneer in educational applications of the new information technologies. The dissemination of innovations in colleges takes place largely by emulation. An individual faculty member, teaching his students as his professors taught him, may change when a colleague with comparable responsibilities models a different, effective approach. A campus may implement an alternative instructional or administrative strategy when another university acknowledged as a leader describes the success obtained with a new approach. Innovative information technology products for higher education will need to be incremental (providing a bridge from old methods to new); generalizable to workplace situations (link to employment); targeted to tiers of adoption (leaders, rising stars, everyone); based around some hardware standard (risk reduction); and easily assessed in terms of effectiveness and efficiency.

Reasonably Probable

• *troubled citizens*--as the technological and bureaucratic complexity of society increases and the economic situation remains uncertain, social instability and change and a growing sense of powerlessness will cause difficulties in coping for many people. Reliance on the advice of "experts" for most decisions will continue to be necessary, yet citizens will resent making choices on blind trust. Heightened values conflicts will continue, as multiple special interest groups do battle on issues such as abortion, individual rights and responsibilities, immigration, protectionism, and biomedical manipulation.

• *a continuing movement for educational reform*--instructor certification will increasingly stress depth in disciplinary preparation rather than pedagogical competence. In Texas, as the "no pass, no play" controversy demonstrates, revisions in educational practices will be heavily impacted by political and ideological factors. The rivalry among postsecondary institutions will increase as funding tightens and the state seeks to eliminate overlapping academic programs. The recent recommendations of the state task force on higher education (parallel to H. Ross Perot's committee which scrutinized pre-college instruction) follow the same pattern: prescriptively detailed, top-down, and focused on assessing readily measurable outcomes.

• *low statewide coordination of Texas precollege educational system*--funding is 46% state funds, 46% local, and 8% federal. This gives little leverage for centralized decision making and creates difficulties in articulation between precollege and postsecondary vocational and technical education. While "top down," the recent reforms mandated by House Bill 72 are unlikely to be implemented because they are unwieldy and expensive. For example, a second grade teacher is responsible for eight curriculum

areas involving 214 "essential elements;" for a class of twenty-two students, that teacher must report on 4708 areas of student progress.

Conceivable/Uncertain

• *a new definition of "national security"*--military and geographic dominance is giving way to a more complex conception that includes economic clout. Japan is now a "financial superpower," spending little on her own defense, but nonetheless secure and strong. At a national level, increasing emphasis may be given to balancing weaponry power and strategic military alliances with economic strength and a positive balance of trade. This shift is likely to fuel funding for economic redevelopment, but may limit and politicize the options of domestic multinational corporations, as the interests of the state are weighed against the interests of shareholders.

• *a weakening of democracy*--financial pressures on citizens will intensify existing anti-taxes movements, and business groups will link anti-regulatory arguments to this cause. The result will be a pervasive "reduce governance" stance. Conflicting pressures will come from those who push for "strong leadership" to ride roughshod over inconvenient regulations and safeguards. Representative government will thus be eroded by pressures both for localism and for unitary authority.

• *changing social responsibility of corporations*--in addition to being responsible for "externalities" (such as pollution) and for national security (through managing economic resources), companies are increasingly being held accountable for developing and maintaining human resources. This ranges from worker retraining to keep competitiveness in the global marketplace to some responsibility for placing workers in new jobs if a business fails. The ethics which corporations should follow in prioritizing simultaneous, sometimes conflicting responsibilities to workers, stockholders, customers, the region, and the nation are not clear.

• *corporate competition with postsecondary vocational, technical, and adult education*--a growing number of U.S. businesses are sponsoring large-scale internal educational programs. Some programs are intended to substitute for entry-level educational credentials as a means of job access; others provide an alternative to colleges and universities for obtaining advanced degrees. (For example, Wang Industries has the Wang Institute, a graduate school in computer science designed to internally produce corporate employees with a Master's degree. IBM, Xerox, GE, and AT&T now offer bachelor's degrees; the Arthur D. Little firm gives an M.B.A. in management; and the Rand Corporation offers a Ph.D. in Public Policy.) Most corporations would rather have public institutions do their training and retraining than mount internal programs in direct competition. However, many businesses are dissatisfied with the quality of the services they receive from educators and--if a well developed, capital intensive model of corporate instruction were available--might implement internal, technology-based training as an alternative. Even if degrees were not offered in most of these programs, such a development would seriously erode the public adult retraining market; strong linkages between postsecondary education and business are needed to prevent this eventuality.

Long Range

• *coordinating knowledge production and distribution becomes the overarching function of postsecondary vocational, technical, and adult education.* This would include:

--anticipating emerging needs for knowledge in the business community
--developing in regional educational institutions the capacity for training appropriate levels of human resources with this knowledge
--working in partnership with business to enhance the economic effectiveness of current approaches and employees

Such a mandate could include expanding educational services to all adults, using partnerships among postsecondary educational institutions, families, communities, industries, and the media. A recent study indicates that California may enjoy a stronger regional economy than Texas in part because of its consistent support of higher education research and development and recommends that Texas view investments in colleges and universities as strongly linked to economic development.

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CHAPTER 7

A SURVEY OF DEANS AND DIRECTORS OF POST-SECONDARY VOCATIONAL EDUCATION IN TEXAS

By:

Karla M. Back and O. W. Markley

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CHAPTER 7

A SURVEY OF DEANS AND DIRECTORS OF POST-SECONDARY VOCATIONAL EDUCATION IN TEXAS

Purpose of the Survey

As we began the assessment phase of our research on emerging instructional technologies, looking at planning guidelines or models for successful implementation, it became clear that there was a wide variation from college to college and program to program. We thought it appropriate, therefore, to survey the deans and directors for vocational-education programs at the post-secondary level in Texas, to provide a clearer picture of which instructional technologies are now being used and what future needs are perceived.

Also, we wanted to gather input from the individuals (vocational-education deans and directors) who would most likely be using the planning guidelines and directly involved in deciding which instructional technologies should be implemented. Specifically, we were interested in assessing which of the instructional technologies available now are most actively used; which are currently being acquired and installed; and which ones decision-makers are interested in learning more about.

Regarding the planning guidelines and model(s), we asked what priorities the deans and directors had in using these emerging instructional technologies, and what type of assistance would be most beneficial to them. Finally, we inquired how this information and material could best be disseminated from their perspective.

The project advisory also felt it beneficial to secure the names, by region, of other individuals and organizations who might be knowledgeable about factors influencing economic development, training, or the various employment and planning activities that affect these issues state-wide. The names and addresses we have gathered are listed by region at the end of this chapter.

Survey Results

The survey results from across the state were enlightening; they clarified two major trends: where institutions seem to be moving with regard to instructional technologies, and which ones are still in the "incubation" stage of acquisition and implementation. Of the 50 surveys we mailed to post-secondary deans and directors across Texas, 29 were completed and returned, for a 58% response rate. Regarding the survey itself, we received numerous positive comments and inquiries about what the information would be used for. Only two respondents either did not understand the majority of the technologies listed, or thought the survey inappropriate and unimportant.

Over 70% of the respondents indicated they are actively using available instructional technologies, ranging from overhead transparencies to desktop publishing; 64% are actively using CAD/CAM; while the remainder of the respondents are either acquiring this technology now, or know about it.

On the other hand, knowledge and use of four higher-level instructional technologies is much lower. Only 18% of the respondents are actively using interactive videodisc, while 46% want to know more about this technology. Only 11% of the respondents are currently using automated authoring systems, with 71% wanting more information. Although only 7% are actively using expert-system "courseware," 82% show an interest. Finally, 4% are actively using hypertext, with another 7% in the process of acquiring and implementing it, and 79% seeking more information.

Our second question asked the respondents to rank, in order of importance, the activities they most wanted assistance with in planning for and implementing these instructional technologies. By far, the top priority was (b) assessment of need and "fit" of emerging instructional technologies; (a) identification of new technologies and their applications was second; (c) planning for implementation, third; while (d) implementation of the instructional technology ranked last.

Our third question concerned the type of guidelines and

model that would be most helpful in planning for and implementing these technologies. A majority, 58%, of the respondents indicated that narrowly focused checklists would be more helpful than general guidelines, while one respondent said, "send both".

Regional workshops and reports such as this were the only forms of dissemination suggested by a majority of respondents. Only a third felt teleconferences would be helpful, while less than 20% felt a local or state-wide workshop would be most helpful. A copy of the tabulated results and the cover letter that accompanied the survey are included in this chapter for reference.

"Knowledgeables" or and other Sources Throughout the State

In all, 21 individuals and other sources to contact were recommended by deans and directors from various regions of the state. The Gulf Coast Region provided five such sources of information; the Border Region provided one; the Plains Region listed two; the East Texas Region offered six; the Metro Region supplied three; and the Central Corridor Region listed four. The list, which is provided here for easy reference, should prove helpful in securing additional information from both regional and state-wide sources.

INCREASING THE PRACTICAL USEFULNESS OF RESEARCH ON PREPARING FOR THE FUTURE OF THE WORKPLACE AND EDUCATION IN TEXAS: A SURVEY OF DEANS AND DIRECTORS

rections: As summarized for you in our cover letter, we are interested in gathering your ideas and opinions regarding how st to report our findings on The Future of the Workplace and Education in Texas for your use. Please answer each question oughtfully, after considering how you and your peers would prefer to see outcomes of our study communicated. Room is ovided for comments or additional ideas after each question. We welcome your ideas.

To help us gauge your present and future uses of instructional technology, please indicate the following. (Note that we are defining instructional technology as what is used, not what it is used for. Examples: word processing, not clerical kills training; or CAD/CAM, not instruction in drafting and manufacturing).

Available Instructional Technologies	Actively Used Now	Currently Being Acquired or Installed	Know Something About	Want to Know About
Overhead Transp.	100 %			
35 mm Slides	96 %			
16 mm Movie	82 %			
Video Cass. (VCR)	100 %			
Videodisk TV	46 %	11 %	4 %	15 %
Word Processing/ Spreadsheets	93 %	4 %		2 %
Computer Graphics/ Desktop publishing	71 %	18 %		7 %
CAD/CAM	64 %	11 %	11 %	4 %
Office Automation/ Networking	46 %	18 %	4 %	15 %
Interactive Videodisc	18 %	7 %	21 %	46 %
Automated Curric. Authoring Systems	11 %		18 %	71 %
Expert System "Courseware")	7 %	4 %	7 %	82 %
Multimedia Hypertext	4 %	7 %	7 %	79 %

ments or other ideas

In order to integrate your use of technologies such as the above more effectively, please rank in order of importance, from 1--4 (with 1 being the highest priority and 4 being the lowest need), which of these activities you would most like to receive assistance with:

a. 2nd Identification of new technologies and their applications in postsecondary institutions.

b. 1st Assessment of needs and "fit" of emerging technologies with needs.

c. 3rd Planning for implementation.

d. 4th Implementation.

Comments and other ideas: _____

If you were to be given assistance on how to better identify, assess, and implement emerging instructional technologies, and to integrate them with those you already use, would it be more useful for you to receive information in the form of: (1) a general model and flowchart of steps to follow; or (2) a checklist of specific questions or criteria to apply?

8 A broad model and flowchart

19 More narrowly focused checklists

Comments and other ideas Both 1

4. How best should information on "The Future of the Workplace and Education for Work in Texas" be disseminated?

a. 6 local workshops 4

b. 15 regional workshops 2

c. 4 state-wide workshop 5

d. 10 teleconference presentation 3

e. 16 written format 1

f. ____ other 0

Comments or other ideas Ranking order Ranking order

Name of Person Completing Survey _____

Name of College/Campus/Institute _____

Telephone number _____ Mailing Address _____

(If you would like a copy of the summarized results of this survey, please check here: ____)

COMMENTS ON THIS SURVEY: _____

(use reverse side if needed)

(Please feel free to detach this page and have it completed by whoever you think is able to complete it most knowledgeably)

What individuals and/or organizations are in your judgement most knowledgeable about economic development and future employment needs in your region (sources who might be contacted to identify specific "plans in the pipeline" and other factors influencing economic development, the emerging nature of employment, and related occupational training needs in Texas).

Name _____

Organization _____

Telephone number _____ **Mailing Address** _____

_____

Comments or Other Names _____

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ISI The Institute for Strategic Innovation

P.O. Box 1039 • Clear Lake Shores, Texas 77565 • 713/334-2606

Date: February 12, 1988

To: Community College or Technical Institute Dean or Director

From: Karla Back
President and Project Coordinator

Re: Helping us help you employ emerging instructional technologies more effectively

Under subcontract from North Harris County Community College, ISI is conducting research to help the Community Colleges and Technical Institutes implement Master Plan objectives that promote:

- Delivery systems based on emerging needs;
- Competitive, cost-effective, state-of-the-art instructional technologies; and
- Resource funding and implementation via public-private collaboration, rather then by the public sector only.

To prevent our report on "The Future of the Workplace and Education for Work in Texas" from becoming just one more research report to sit on the shelf, we would like your advice as to how we can make our findings most useful to you.

Among the several objectives our final report is to fulfill are these two: (1) Forecasts on emerging instructional technologies (information that you and your people may soon want to consider); and (2) Planning models and/or guidelines (expressly designed to help you integrate foresight into needs assessment, program planning and implementation decisions).

Would you be willing to take a few minutes to advise us how to best to communicate this work? Thank you in advance!

Please complete and return the questionnaire in the enclosed envelope so that we can begin analyzing your needs and ideas by March 1, 1988.

Breakdown of last question on Voc Ed Deans/Directors Survey on Key Knowledgables or Sources in Regions Who Might Identify "Plans in the Pipeline" or Other Factors Influencing Economic Development, Nature of Training Needs or Employment

GULF COAST REGION

Name of Source/Contact Information	Referred By
1. Irma Cabellero Director of Jobs Training City of Corpus Christi 512-880-3000 PO Box 9277 Corpus Christi, Texas 78469-9277	Dr. J. Kostoch Del Mar College 512-881-6400 Baldwin/Ayers Corpus Christie Texas 78404
2. Mr. Malcolm Hunter Galveston SBDC 409-763-4426 4015 Avenue Q Galveston, Texas 77550	Dr. Marc Nigliazzo Galveston College 409-763-6551 4015 Avenue Q Galveston, Texas 77550
3. Delora Wilkinson Henry S. Miller Realtors 713-468-8311 13130 Memorial Drive Houston, Texas 77079	Dr. Kenne Turner North Harris County College 713-875-1515 233 Benmar Drive Suite 150 Houston, Texas 77060
4. Charles Pendelton BEDCO 409-239-2416 200 West 2 nd Freeport, Texas 77451	H. E. Miles Brazosport College 409-265-6131 500 College Drive Kale Jackson, Texas 77566

5. Pretiss Harver & Rick Bilheimer
JTPA
713-476-1501 x 637
8060 Spencer Highway
Pasadena, Texas 77505

Clay Kelley
San Jacinto College
Central Campus
713-476-1806
8060 Spencer Highway
Pasadena, Texas 77505

BORDER REGION

1. Stan Wright
Project 90
915-779-6623
1155 Westmorland
Suite 130
El Paso, Texas 79925

Dr. Diane Troyer
El Paso Com. Coll
915-534-4038
Box 20500
El Paso, Texas
79998

PLAINS REGION

1. Mary Elliott
Vernon Regional Junior College
817-552-6291
4400 College Drive
Vernon Texas 76384

Dr. Joe D. May
Vernon Regional Junior College
817-552-6291
4400 College Drive
Vernon, Texas 76384

2. Russell Autry
Chamber of Commerce
915-332-9111
400 West 4Th
Odessa, Texas 79761

Ken Hurst
Odessa College
915-335-6508
201 West University
Odessa, Texas 79762

EAST TEXAS REGION

1. Jim Davis
Business & Ind. Dvlt. Center
Northeast Texas Comm. College
214-572-1911

Jack Foreman
NE Texas Com. College
214-572-1911

EAST TEXAS

1. Bob Burke
Texas Education Commission
P.O. Box 2152
Longview Texas 75602
214-758-1783

Beryl McKinnerney
Kilgore College
1100 Broadway
Kilgore, TX 75662
214-983-8170

2. Bob Herndon
Longview Chamber of Commerce

Same as above

3. Dr. Joe Hendrix
Longview Center
Kilgore College

Same as above

4. Dr. John Moss
Chairman
Northeast Regional Planning Committee
President ETSU Texarkana Cam.
2500 Robinson Road
Texarkana Texas 75501

Bobby R. Walters
Paris Junior College
214-785-7661
2400 Clarksville Street
Paris, Texas 75460

5. Jim Goerke
Ex. Director
Ark-Tex Council of Govt.
POB 5307
Texarkana Texas 75505

Same as above

METRO REGION

1. Joyce Helens
Collin County Comm. College
214-548-9971
2200 West University
Mc Kinney, Texas 75069

John Hart
Collin County Community Coll
214-548-9971
2200 West University
Mc Kinney, Texas 75069

2. Texas Instruments
Training Division

Alan Scheibmeir
Grayson County College
214-465-6030
6101 Grayson Drive
Denison Texas 75020

3. Jim Picquet
North Lake College
214-659-5340
5001 N. Mac Arthur Blvd.
Irving, Texas 75038

Suggested by self / call him re: TAET Texas Ass. Educational Technology - find out how to contact pres of TAET.

CENTRAL CORRIDOR REGION

1. Ruben Torres
Cont. Education Dean
San Antonio College
512-733-2637
1300 San Pedro Avenue
San Antonio, Texas 78284

Tessa Tagle
San Antonio College
512-733-2440
1300 San Pedro Avenue
San Antonio, Texas 78284

2. Stephanie Coleman
Director
Economic Devlpt. Foundation
512-226-1394
POB 1628
San Antonio, Texas 78296

Same as above

3. Dave Sugg
Target 90 - Goals
for San Antonio
512-227-0207
1222 N. Main
San Antonio, Texas 78212

Same as above

4. Texas Employment Commission
Waco Office
No # or address given

Don Pierson
TSTI - Waco
817-799-3611 x 2053
TSTI Waco
Waco, Texas 76705